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IN THIS ISSUE . . .

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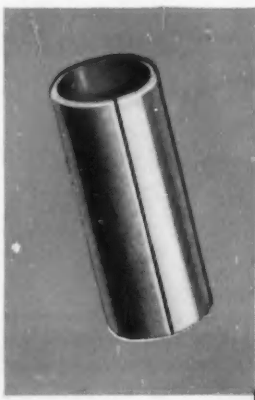

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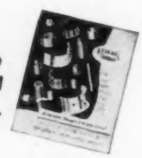

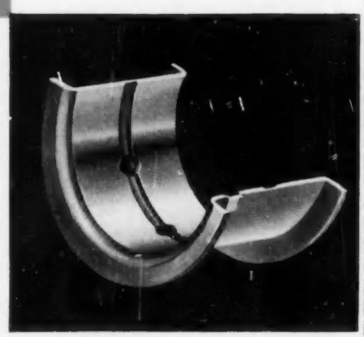

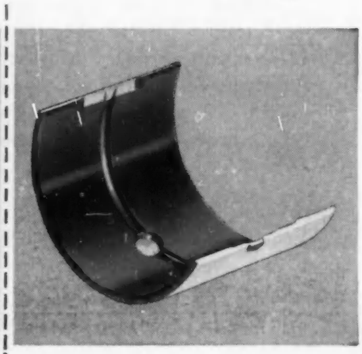

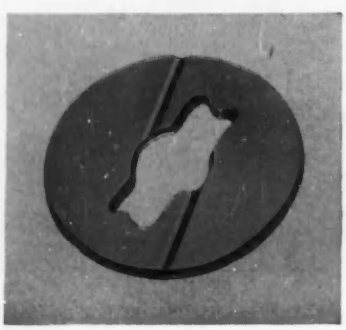

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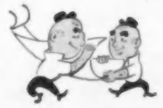

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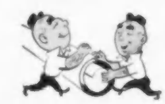
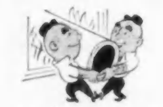
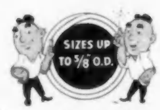


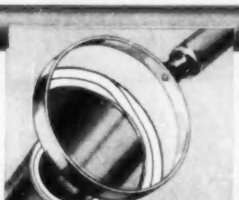
continuously rolled twice around laterally into a tube of uniform thickness,



and passed through a furnace. Copper coating fuses with steel. Result . . .

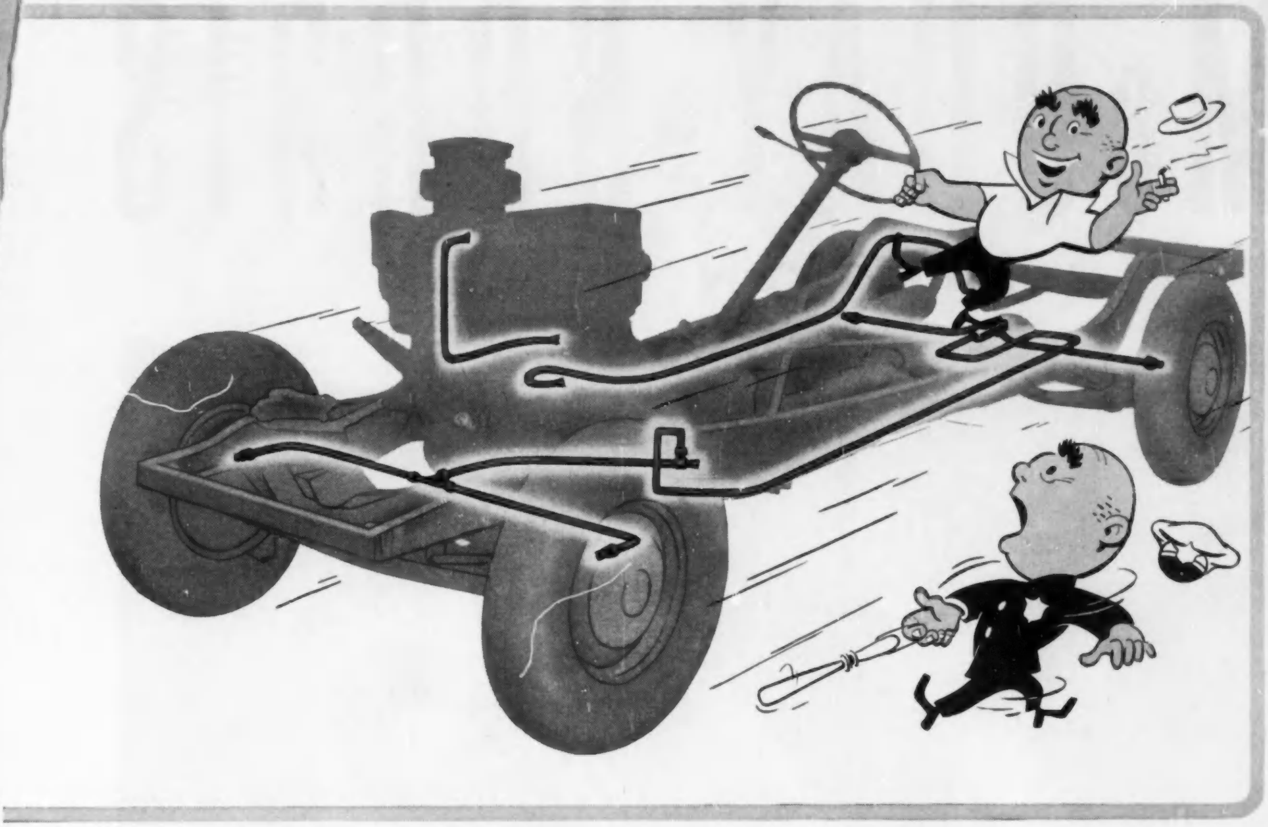


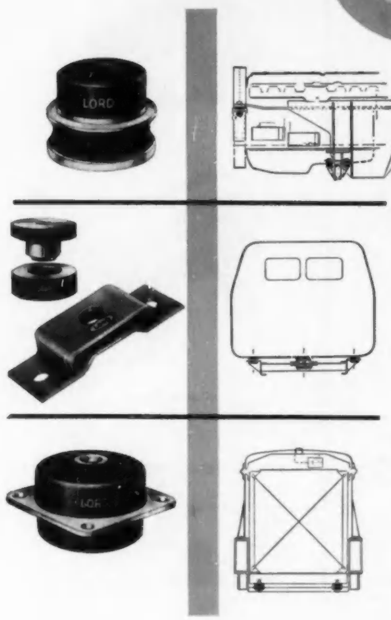
Bundyweld, double-walled and brazed through 360° of wall contact.



←

NOTE the exclusive Bundy-developed beveled edges, which afford a smoother joint, absence of bead and less chance for any leakage.





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For the Sake of Argument

Attitudes in Action

By Norman G. Shidle

Attitude often outranks action in business relationships. Especially in getting help from others does the heart's true aim make a major difference.

Two men, for instance, in the same engineering department, right now are taking similar actions with very different attitudes. Both require the active help of associates over whom they have no authority. One asks for help sparingly: "It's my job to do," he says. "I feel sheepish and inadequate when I dump my problems on others."

The other asks for help regularly—and tends to let his routines readjust themselves to make the assistance permanent.

The one has people looking for a chance to help him. The other is puzzled at the slow, gradual resistance to his requests that seems to be building up.

"Do most people like to help others?" someone asked N. Y. Journal-American psychologist Joseph Whitney recently. Whitney answered: "Yes, especially if they have good reason to feel the help is needed and deserved. . . . All of us are inclined to shun the dead-beat, because of our fear of being played for a sucker."

Almost everybody gets satisfaction from doing a favor. Almost nobody likes to do somebody else's work.

Whether an associate gets a chance to do a favor or not depends entirely on the attitude of the one helped. When the asker knows that the other fellow has problems more important than his own, he attracts help from almost everybody.

The minute the idea "you *ought* to help" enters, resistance follows.

Sure, people are funny—but we're all people.

SAE JOURNAL

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Society of Automotive Engineers, Inc.

Robert Cass
President

John A. C. Warner
Secretary and Gen. Manager

B. B. Bachman
Treasurer

1953 SAE President Robert Cass

1953 Annual Report

Before last January's Annual Meeting had closed, President Cass and his 21 Council colleagues had started work on 1953 activities. Their year of Society business has witnessed new undertakings, loftier levels of achievement and shattered records in many areas.

The Council has been gratified to admit more new and fully qualified members than in any previous year, bringing the total to an all-time high.

President's Message . . .

Shortly before I entered into my duties as president of the SAE, my predecessor, D. P. Barnard, pointed out the rewarding experience that lay ahead of me. The glowing accounts he gave of the meetings that he had attended have certainly been repeated in my year's experience.

I am particularly conscious of the education that I have received from my contact with the membership of SAE and I am very grateful, indeed, for that phase of my experience.

I am also very conscious of the work that goes on behind the scenes to make all the meetings so well-handled, well-prepared, paperwise, and so productive of exchange ideas. Whilst I have been very conscious of the feeling that exists in SAE with regard to exchange of information, it is a new experience to see it happen at so many meetings. Basic ideas as well as details dealt with in our meetings in many other countries are closely hugged to the breast and considered secret. Not so in SAE, and it is a most refreshing experience to be seeing this frank and open approach to problems of our age.

I've learned to appreciate more than ever that the strength of SAE is based on the local Sections who by their active participation give direction and emphasis to the aims of our Society.

The Summer Meeting this year at Atlantic City was acclaimed on all sides as being outstanding and for the many members of the committees that were responsible for developing the programs and in carrying them through to completion, this must indeed be a source of gratification. The thanks of upwards of two thousand people who attended are well deserved.

One of the most important aspects of our Society is to make certain that we keep strong financially and are able to carry out the services to members that—as you so well know—cost much more than our annual dues. To this end, my acquaintance this year with the workings of the Finance Committee has left me with a deep feeling of satisfaction that we are, indeed, in good hands and also that the staff in turn have full realization of the need of keeping the Society strong and able.

I learned also of the splendid work done in interesting industry in financial participation in SAE technical committee work which serves industry. These services to industry have done much to put the Society in the foremost position it occupies among engineering societies throughout the world.

Every member who reads the SAE Journal must be awfully proud of how splendidly it reflects the activities of the Society and the technical information contained in SAE papers and committee reports. The Journal needs nothing on my part in the way of recommendation for the membership to realize that it is unquestionably the outstanding publication of its kind in the country. The Publication Committee deserves special congratulations.

When the year ended, I had visited every Section and every Group from east to west,—including the Hawaiian Islands—and the getting of the cross-section of the points of view of our engineers in the different phases of our Society have been to me an education that could have been secured in no other way.

In thanking as I do so sincerely the members of all the committees who have made such a splendid contribution to the success of the SAE this year, I should be lacking in many ways if I did not bring at this time to your attention the splendid staff that the SAE has throughout the country, in New York, Detroit and the West Coast. Efficiently and quietly they work steadily towards the objectives of the SAE and deserve our warmest thanks for a job well done.

R Cass

Robert Insley
Chairman
Sections Committee
and
Constitution Committee

E. S. MacPherson
Chairman
Technical Board

H. E. Chesebrough
Chairman
Meetings Committee

T. B. Rendel
Chairman
Publication Committee

M. A. Thorne
Chairman
Public Relations Committee

The same may be said of dollars to make the Society more comfortable financially, sounder than ever.

Steps have been taken to encourage appropriate types of rotation in committee personnel and to bring more of the younger members into active participation in Society work. The L. Ray Buckendale Lecture Series has been established. Progress has been made with plans for the Society's Golden Anniversary in 1955. Expansion in meetings and display programs has been established. Extension of Production Forum effectiveness has been developed.

Exercising top-level responsibility as the Society's "Board of Directors," the Council has been pleased to endorse and put into effect scores of recommendations from working committees. Specific facts about accomplishments of hundreds of SAE men in action are high-spotted in the following pages.

Constitution Revisions Adopted

Revisions to the Constitution, recommended by the Constitution Committee and approved by the Council, submitted by letter ballot to the voting membership became effective April 1, 1953.

These revisions covered abolition of Service and Foreign Member grades; waiving of initiation fee for Enrolled Students who apply for membership in their post-collegiate year; clarification of qualifications for Member grade; and permission for Juniors and Associates to serve as members on Professional Activity Committees.

Technical Committees Work on Diverse Problems

A broad program on a diverse list of problems has been carried on during the past year by technical committees operating under the Technical Board. Undoubtedly, the most dramatic assignment of the year was that given the Advisory Committee to the Federal Civil Defense Administration to assist in the development of the test program on the effects of an atomic explosion on automobiles and to observe and evaluate the actual tests. A preliminary report by this committee in the form of a Summer Meeting paper was one of the high spots of that event.

Work was initiated during the year on eliminating differences in the Society's aeronautic and automotive drafting standards. A joint aero-auto drafting standards committee was organized to handle this job and it has been working vigorously. Currently, it is concentrating on defining geometrical relationships on drawings, a problem which is also the subject of joint consideration by Great Britain and the United States.

A new Division of the Iron and Steel Technical Committee has been set up to study residual stresses. The announcement that this work would be undertaken was met with widespread interest and enthusiasm and experts from more than 30 companies have indicated a desire to participate. This, of course, is a long range project. Other ISTC Divisions which have been unusually active are shot peening, tool and die steels, carbon steels, alloy steels and bolts, nuts, and fasteners.

For its work on cockpit standardization, The

Flight Safety Foundation has awarded Committee S-7 of the Aeronautics Committee a plaque for "Achievement in Flight Safety." This is but one of a number of active and important projects under the Aeronautics Committee. All together this Committee produced 141 new and revised Aeronautical Material Specifications (AMS), 12 new and revised standards and recommended practices, and several hundred recommendations to the military services on specification matters. Incidentally, sales of 722,000 AMS during the year brings the total of these specifications distributed in the last 13 years to 7,800,000. One of the interesting and difficult new projects undertaken by this Committee is the development of packaging and shipping procedures to protect delicate aeronautical instruments against transportation hazards.

The Tube, Pipe, Hose, and Lubrication Fittings Committee has about completed a letter ballot of groups substantially concerned on a proposed revision of the present SAE Standard for Refrigeration Tube Fittings. Present indications are that the ballot will result favorably and, if so, it is planned to recommend the standard to the American Standards Association for adoption as an American Standard.

A move directed toward the standardization of the larger sizes of disc wheels has been launched. The purpose is to reduce the mounted tire inventories now necessary for operators of mixed fleets to carry. Partial interchangeability is the immediate objective as a step to more complete standardization in the future.

Reflecting changes in industry practice, a new standard for plastic insulated low tension cable is under development. The Commercial Vehicle Nomenclature Standard is undergoing complete revision. Work has been started on the development of standard filter test methods. Active programs on industry standardization and on cooperative projects with the Army Engineers Corps are in progress on construction and industrial machinery.

To improve rear lighting of motor vehicles, particularly trucks, major increases have been made in the minimum candlepower requirements for tail lamps. In addition, the photometric specifications for Sealed Beam headlamps are being modified to conform to the improved units developed under the auspices of the Automobile Manufacturers Association. These improved lamps probably will make their appearance on 1955 models.

New Peak for Meetings Attendance

The 12 National and International meetings held throughout the United States and Canada during 1953 broke just about every record in the SAE's book:

Total registration of 15,300 topped the 1952 record by more than 1,700.

Nine of the twelve meetings established new attendance highs—Annual, both Production Meetings—Cleveland and Toronto, New York Aeronautic, Summer, Tractor, Transportation, Diesel Engine, and Fuels and Lubricants.

More than 3200 members and guests participated in five production forums held in Cleveland, New

R. R. Faller
Chairman
Student Committee

C. M. Larson
Chairman
Placement Committee

A. T. Colwell
Chairman
Finance Committee

B. B. Bachman
Treasurer

J. H. Booth
Chairman
Membership Committee

York, Milwaukee, Los Angeles, and Toronto. Comparison with the attendance of 1400 at the two production forums held in 1952 graphically illustrates the rapid development of this effective service to SAE members and the automotive industry.

More papers were presented—232—than ever before, and the 54 summary reports of production forums and round tables made available for publication topped all previous records.

The engineering displays hung up new records for size, participation, and attendance.

Income from every meetings source hit new highs—engineering displays, preprint sales, and nonmember registration.

Peak attendance of over 5000 at the 1953 Annual Meeting overtaxed facilities at the Sheraton-Cadillac Hotel so severely that it was decided to spread the 1954 Annual Meeting to two hotels—the Sheraton-Cadillac and the Statler. Purpose of the move is to accommodate for the first time in years all who desire to attend technical sessions, to hold committee meetings, or to participate in the engineering display.

Two innovations were mainly responsible for the record registration of 1620 at the New York Aeronautic Meeting—the first Aeronautic Production Forum held in conjunction with this meeting and a full day of confidential sessions.

The first inspection trip taken by any organization to the Arnold Engineering Development Center in Tullahoma, Tennessee, was another feature of this meeting. An SAE-chartered DC-6 transported the group to Tullahoma and return within one day.

Technical highlight of the SAE's largest Summer Meeting was a Symposium on Arctic operation in which top international authorities participated. The World Tour Varieties costume party and entertainment provided the social highlight.

The West Coast Meeting in Vancouver, B. C., in August, was the first of two International meetings held in Canada. The second was the Production Meeting and Forum held in Toronto in October. Both meetings were outstanding for the quality of their technical programs and for the warm hospitality of their Canadian hosts.

Completing the Fall schedule was the Los Angeles Aeronautic Meeting—the second largest meeting of the year—and the Transportation, Diesel Engine, and Fuels and Lubricants Meetings—all three held in one hotel within one week.

To meet the increasing demand for booths, the engineering display at the Los Angeles Aeronautic Meeting was expanded, as will also be the displays at the 1954 Annual and New York Aeronautic Meetings.

Publication Plans Cover Broad Fields

Formal addition of Junior members to Readers Committees and editorial decisions for the Golden Anniversary Issue of SAE Journal in February 1955 were among Publication Committee developments in 1953. Modification and improvement in the details of Readers Committee procedures for judging material were also begun. (The 14 different Readers Committees of the Publication Committee determine which papers shall be printed in SAE Transactions and advise the editors as regards the abridgments of all papers in SAE Journal.

SAE Journal

Improvements were made in format and handling of several sections of SAE Journal during 1953, particularly "About SAE Members" and "News of Sections." Further progress was made in presenting salient points of technical papers in both words and pictures to interest as wide a segment as possible of all SAE members.

Particular advances were made in use of articles bearing on production and manufacturing, both in quantity and quality. At the same time, a better balance of material was achieved to serve all of the Society's Activity areas. The practice of abridging oral as well as written discussion in connection with papers presented as SAE Journal articles, which was inaugurated in 1952, was carried further.

Editorial pages in SAE Journal totalled 1109 during the 1953 calendar year. Of these 685 were technical articles—and 122 in addition were devoted to coverage of SAE meetings.

The first special production issue of the SAE Journal was published in May, 1953. It grew out of an expansion of the meetings programs and activities sponsored by the SAE Production Activity Committee. The editorial content of this issue, stemming from Production Meetings papers and Production Forum reports, highlighted developments of mutual interest to production men and design engineers.

Featured in the Golden Anniversary Issue of the SAE Journal February, 1955, will be a group of 12 articles, representing each of the Society's Activities, each written by an outstanding engineer. The articles will stress the challenge ahead in terms of the achievements during SAE's first 50 years.

SAE Transactions

Beginning with 1953, SAE Transactions is being issued annually in a single bound volume. The 1953 issue went in the mails on August 27, several weeks ahead of its schedule. The 1954 issue is expected to be mailed about August 15, 1954.

The 1953 volume carried 732 as against 788 pages in 1952.

Special Publications

Total volume of Special Publications sales in the 1952-1953 fiscal year was $41,567. There were 113,453 pieces of material distributed. (Comparable figures for 1951-1952 were $37,968 and 122,515.)

These figures comprise the Society's sales of meetings papers in addition to those sold at meetings, of ground vehicle technical committee reports and manuals, of reprints from the Society's publications, and of SAE Rosters.

SAE Handbook

The 1953 SAE Handbook contained 1032 pages, an increase of 86 pages over the 1952 book. Twenty new reports were added, and 54 reports were revised.

Almost 19,000 of the 1953 SAE Handbooks have been distributed, as compared with 14,500 of the 1952 issue and 13,000 of the 1951 issue. Indications

are that the bigger 1954 SAE Handbook will achieve even wider distribution.

During the past year, the Council approved a new pricing policy which will become effective with the 1954 edition: Members will, as usual, be entitled to one copy free. Additional copies will be available to members at $10 each copy. Price to nonmembers will be $20.

Public Relations Policies Are Reviewed

The Public Relations Committee in 1953 made a detailed review of the Society's public relations activities and formally reaffirmed the policies under which the work had been conducted. Important in these reaffirmed policies are the following:

"SAE Public Relations effort shall be directed primarily at the following four objectives;

1. General executives of companies throughout the automotive industries;
2. Our own SAE members—with special reference to those occupying supervisory engineering positions;
3. Educators and Student Branches;
4. Civic, political, and economic leaders.

"The relative importance of these objectives is in the order of their listing."

The Public Relations Committee also began sponsorship of an SAE Golden Anniversary Emblem Contest. From designs submitted by SAE members and SAE Enrolled Students, the Committee will select a winning emblem which will be used officially by the Society in decoration, printed matter, and other displays during celebration of its Golden Anniversary in 1955. Entries for the Emblem Contest close April 7, 1954.

Attendance Up At Section Meetings

SAE Sections and Groups are reporting increased meeting attendance and growing member participation in activities. Coordinated local programs have been largely responsible for attracting a record number of new members to the Society. Sections and Groups also have participated in the Society's Student program and its Placement Service.

SAE President Robert Cass was an honored guest of every SAE Section and Group during his administration, either at the time of a National Meeting or at a special Presidential meeting.

Professional Activity Committees are cooperating with Sections and Groups by providing lists of paper suggestions appropriate for local meetings and by cooperating in securing speakers for their programs.

Newest of SAE Sections, Texas Gulf Coast, was born at the start of the 1953-1954 Section year. Nurtured as a Division by the Texas Section for more than a year, it had the parent Section's blessing when the Council approved it as an independent Section. Headquarters of the new Section are in Houston. Sections now total 37; Groups 5.

SAE Adds Two Student Branches

The University of Cincinnati became the 48th school, and the University of Missouri School of Mines and Metallurgy the 49th, at which SAE Student Branches have been established. Both were approved during the past year. Informal SAE clubs have been organized at several other schools, and a petition for the 50th Student Branch is now pending.

The Society's Student Enrollment was 4537 at the close of the fiscal year. An increase in enrollments is anticipated during the coming year, resulting in part from the growing upper-class registrations at engineering schools.

The Council has adopted a plan recommended by the Executive Committee of the Student Committee to facilitate transition of Enrolled Students to SAE membership. To bring graduates more quickly into the Society and provide them with the benefits of membership, first year dues for Enrolled Students elected to membership have been set at $10, and the policy of waiving initiation fees for former Enrolled Students has been continued. Students must fulfill certain requirements to be eligible for these benefits. The extra year of Student Enrollment has been eliminated.

Placement Service Never Becomes Static

Employers' search for men of SAE caliber continues to provide many more openings than there are men to fill them. In fact, the volume of offers to some has made reply to all inquiries physically impossible. Therefore, to maintain favorable employer attitude toward SAE, a postal card is now furnished which permits prompt initial reply from an SAE member with no more than a check mark at the proper point.

Under these conditions of supply and demand, the very bulk of the "Positions Available" bulletin has dictated the issuance every other month of only the "New Openings."

Both of these moves have met with general approval and not one single adverse comment.

The Placement Service continues to operate confidentially and by code number.

Plans Made By Finance Committee

The SAE Finance Committee has prepared a budget with a view to current needs. The new budget provides for more Rosters, Handbooks, and Journals for the larger membership. More Student Branches need operating funds. Larger and more intricate National Meetings play their part.

The New Budget

The 1953-54 Budget, approved by Council, is higher than its predecessor in both income and expense but does provide two safeguards. The first is the prediction of volatile advertising revenues

some $60,000 lower than last year's results. The second is an ultimate black figure of $37,000 to add to Reserves and bring them more in line with expanded operations.

Investments

U. S. Government bonds make up 75% of SAE investments. The other 25% is in equities for the purpose of protecting the purchasing power of SAE dollars in an inflationary period. Advising on this latter is Bankers Trust Company which is credited with handling more Pension Trust Funds than all other institutions combined. And the record to date, while the market has been far from buoyant, is considerably better than the best known averages; but at current writing the fund is slightly off from original cost prices.

Current

The Finance Committee follows operations closely on a monthly basis and recommends to Council such interim adjustments as seem desirable.

Technical

The recognition by industry of the value of Technical Committee work seems inherent in the increased financial support of last year. Demand for the work is at an all-time high.

The Outlook

The Finance Committee believes that the current financial competence of SAE is adequate to allow time for orderly retrenchment in case of need. In the meantime, conservative optimism appears most constructive.

Treasurer Takes Stock

The Society's audited figures, plus a simplified chart on Income and Expense, form part of this report, but special mention is made of the following key figures.

Income and Expense

Both income and expense figures hit a new high; and $18,000 was added to RESERVES. Member Dues totaled $439,000 and Advertising Revenues from the SAE Journal and Handbook were $455,000. In addition, industry once more put a stamp of approval on the benefits of Technical Committee work by providing $203,000.

Financial Problems

High technical committee activity resulted in another slight depletion in the Credit formerly set up for this activity and so earmarked.

Substantially increased member demand for SAE Handbook not only added costs but did not leave the anticipated copies for outside sales. This had the effect of higher cost plus less than predicted income.

Current Status

SAE is budgeted for another black figure which, if estimates hold, will further strengthen General Reserves.

Income and Expense Statement

October 1, 1952 to September 30, 1953

INCOME		
Membership		
Dues Earned	$ 298,638.34	
Subscriptions Earned	101,591.16	
Initiation Fees	38,842.50	
Miscellaneous Membership Income	1,730.00	$ 440,802.00
Publications		
Journal and Transactions Sales	64,561.29	
Journal Advertising—Less Agency Commissions	437,522.25	
Handbook Sales—1952	860.00	
Handbook Sales—1953	19,666.50	
Handbook Advertising	17,319.50	
Aeronautical Publications	57,364.39	
Special Publications	41,566.63	
Miscellaneous Publications Income	5,637.17	644,497.73
National Meetings		
Guest Registrations and Papers Sold at Meetings	16,672.08	
10 Dinners	38,951.75	
3 Displays	25,780.00	
Summer Meeting	14,088.00	95,491.83
Investments		
Interest	15,349.49	
Dividends	4,964.25	
Loss on Sale of Investments	(5,177.71)*	15,136.03
Cash Discounts Earned		1,068.45
Total Member Service Income		$1,196,996.04
Industrial Income for Technical Board Services (including $3027.76 transferred from Deferred Credits)		206,148.26
Total Income		$1,403,144.30

* ( ) Denotes Deduction for Loss

EXPENSES		
Sections and Membership		
Direct Expenses		
Sections	$ 13,957.99	
Section Appropriations & Dues	62,850.00	
Membership and Students	40,968.75	
Western Branch Office	20,969.72	
Miscellaneous Membership Expense	1,279.46	$ 140,025.92
Pro-Rated Administrative Expense (12.9%)		38,106.45
TOTAL—(FORWARD)		$ 178,132.37

EXPENSES—(FORWARD)		$ 178,132.37
Publications		
Direct Expenses		
Journal and Transactions Text	223,412.23	
Journal Advertising	204,730.35	
Handbook—1952	97.36	
Handbook Text—1953	74,100.83	
Handbook Advertising	7,126.44	
Aeronautical Publications	29,515.16	
Special Publications	31,288.82	
Miscellaneous Publications	28,174.59	598,445.78
Pro-Rated Administrative Expense (54.9%)		162,173.98
		760,619.76
National Meetings		
Direct Expenses		
Department Expense	49,203.60	
Cost of Registrations and Papers	7,365.45	
12 Meetings	69,689.88	
10 Dinners	37,572.61	
3 Displays	7,533.09	
3 Awards	1,562.89	172,927.52
Pro-Rated Administrative Expense (15.9%)		46,968.42
		219,895.94
Technical Board Services		
Direct Expenses		
Technical Committee Operations	$ 138,932.94	
CRC Appropriation	30,000.00	
Solicitation Expense	9,065.30	177,998.24
Pro-Rated Administrative Expense (16.3%) Industry Share		28,150.02
		206,148.26
Members' Share		20,000.00
		226,148.26
Total Expenses Composed of:		
Direct Expenses	1,089,397.46	
Administrative Expenses	295,398.87	1,384,796.33
Excess of Income over Expenses		18,347.97
General Reserve at Beginning of Year		820,003.93
General Reserve at End of Year		$ 838,351.90

Balance Sheet

at September 30, 1953

ASSETS	
Cash—Unrestricted	$ 197,834.28
Restricted	17,877.64
Notes & Accounts Receivable—Less Reserves	19,584.68
U. S. Gov't Bonds	562,410.98x
Common Stocks and $143.15 Cash in Investment Advisory a/c	208,302.25x
Accrued Interest and Dividends	3,839.08
Inventories	34,297.24
Furniture and Fixtures—Arbitrary Value	1,000.00
Prepaid Expenses, etc.	37,494.93
TOTAL ASSETS	$1,082,641.08

LIABILITIES AND RESERVES	
Accounts Payable	$ 23,614.99
Section Dues Payable	9,079.00
Deferred Credits to Income:	
Member Dues Received in Advance	116,016.50
Industrial Income for Technical Board Services	36,531.34
Subscriptions	15,723.99
Others	26,793.75
Reserves for Unexpended Memorial Funds	10,385.11
Reserve for Golden Anniversary Expenses	6,144.50
General Reserve	838,351.90
TOTAL LIABILITIES AND RESERVES	$1,082,641.08

x Investments carried at cost—9/30/53 Market Quotation or Redemption values—U. S. Gov't Bonds		$534,264.48
Market Quotation Values—		
Common Stocks	$197,832.50	
Cash	143.15	$197,975.65

Accountants' Certificate

Society of Automotive Engineers, Inc.:

We have examined the balance sheet of the Society of Automotive Engineers, Inc. as of September 30, 1953 and the related statement of income and expenses, and general reserve for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying balance sheet and statement of income and expenses, and general reserve present fairly the financial position of the Society at September 30, 1953 and the results of its operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

New York,
November 16, 1953.

Haskins & Sells

Fourth Consecutive Record for Membership

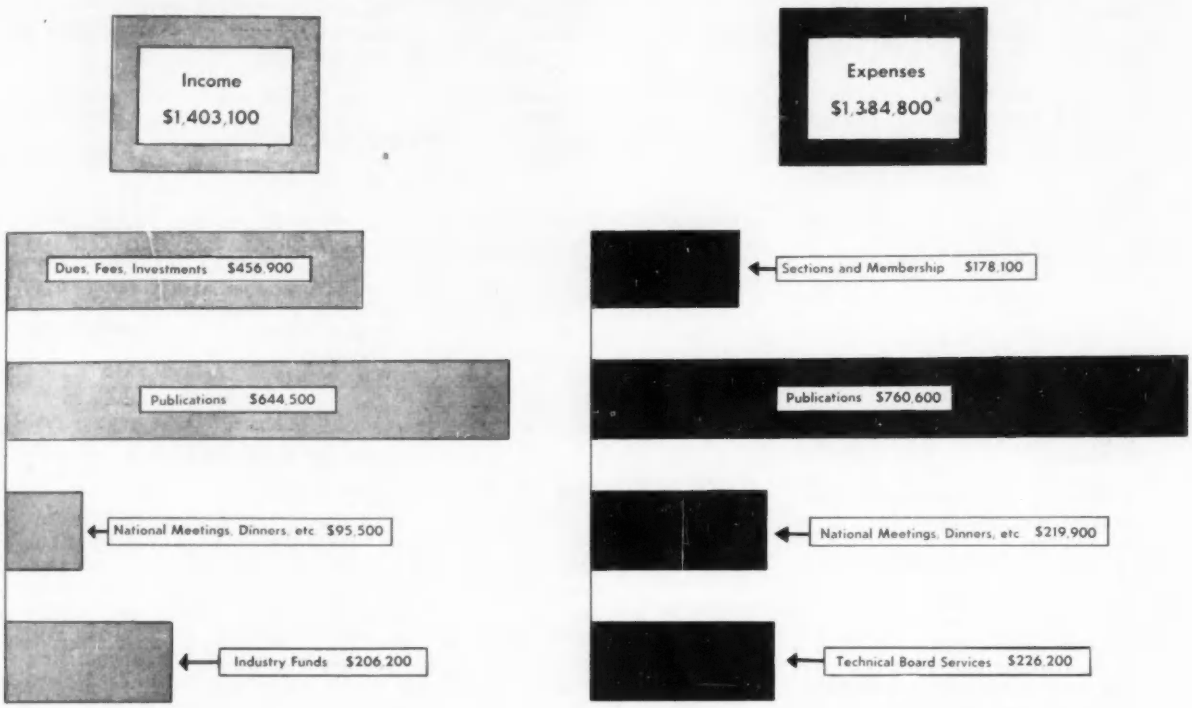
Active SAE members numbered 18,277 as of October 1, establishing a record for the fourth year in a row. The fiscal year saw a net increase of 1543 members to record a 9% gain for the 1952-1953 fiscal year. Additions to membership totaled a record 2544; losses were held to 1001.

Comparative October 1 figures by grades are as follows:

	1951-52	1952-53
Member	9497	10478
Associate	4483	4664
Junior	2754	3135
Total	16734	18277

The membership growth represents coordinated

Where SAE Funds Came from . . . and How They Were Spent



*Includes administrative expenses of $295,400 prorated among the four expense classifications.

action of Section, Group, and Activity membership committees. In all membership promotion areas emphasis continues strong on maintenance of high SAE membership standards.

By amendment to the Constitution, the Society discontinued Service and Foreign Member grades of membership during 1953. All members in these categories have been transferred to Member grade of membership and have received new membership certificates.

During the past fiscal year, 65 members of the Society completed their 35th year of active membership in the Society. These members now carry gold membership cards and are receiving gold illuminated recognition certificates. Silver membership cards are being carried by 162 additional members completing their 25th year of membership. They are receiving silver recognition certificates. Approximately 1400 members (nearly 8% of the total) have held Society membership for more than 25 years.

Grading Committee Activity Increases

During the past fiscal year the Membership Grading Committee has been called upon to review and make recommendations to the Council on 2211 new applications for membership and 369 applications for transfer in grade. Each application was reviewed by at least two members of the committee before it was presented to the Council for final action on election or transfer.

Effective in maintaining the high standards of Society membership has been a continuing program carried on in cooperation with the Membership Committee. Membership committeemen have been urged to screen carefully all prospective candidates, before they are invited to apply for membership, to make certain that they have the necessary technical qualifications and will be desirable additions to the membership. This program is being carried on through talks at membership committee meetings, correspondence with membership committee chairmen, and emphasis to references on their responsibilities.

The Membership Grading Committee has revised the form used in submitting applications for transfer of membership grade, and also its companion reference form. Both forms are now in use. In an effort to obtain more informative replies from references, the committee developed a card requesting references to volunteer comments in addition to answering direct questions.

Upon recommendation of the Membership Grading Committee the Council has approved a new procedure which speeds action on applications for membership of SAE Enrolled Students who are graduates from engineering courses and whose references unanimously favor election.

William Littlewood

1954 SAE President

WILLIAM LITTLEWOOD, president of SAE for 1954, is internationally known as a leading engineer of the air transport industry. He has been recognized for important contributions in development of widely-used American commercial air transports, including the Convair 240, the Douglas DC-3, DC-4, DC-6, DC-6B, and most recently, the DC-7.

"Every project on which Bill Littlewood's mind has played has ended up a better design or a better method than it otherwise would have been," an associate said of him recently. "He always attacks a problem; never waits for it to attack him."

Littlewood is vice-president of engineering, American Airlines, a post which he has held since 1937. Only 10 years before, he had first entered the aviation industry with the Fairchild Engine & Airplane Co. There his start as production manager was a natural outgrowth of the seven years he had just spent, following graduation from Cornell, in the machine tool and heavy machinery manufacturing industry. (He had been with Niles-Bement-Pond and Ingersoll Rand.) He shortly became general manager at Fairchild and, before leaving there in 1930, was responsible for development of the first Ranger aircraft engine.

It was to American Airways, Inc., he moved in 1930, when that airline was being organized by Aviation Corp. of America—of which Fairchild was also a subsidiary at the time. He became chief engineer of the airline three years later. Then he stayed through the company's reorganization in 1934 to American Airlines, Inc., later to assume his present position.

He has been a tower of strength and active assistance to the engineering groups of the industries in which his interests lie—and to Cornell University from which he graduated with an M.E. degree in 1920.

He is a past vice-president both of SAE and the Institute of the Aeronautical Sciences. He is a member of the executive committee of the National Advisory Committee for Aeronautics and a member of the engineering committee of the Air Transport Association. He is also a member of the Committee on Aeronautics, Office of the Assistant Secretary of Defense (Research and Development).

He won SAE's Wright Brothers medal in 1935, and was 1952 Wright Brothers Lecturer for IAS. As a speaker and writer, he has made outstanding contributions to engineering thinking, particularly in the area of future trends in aeronautic design. Study of his writings about "what's ahead" during the last decade show subsequent events have confirmed his interpretive, fact-based prophesies in an amazing number of instances.

In SAE, he was the first vice-president representing Air Transport Activity, when that Activity came officially into being in 1945. He has been a director of the Coordinating Research Council, has served on SAE technical committees in the aeronautical area.

His unique qualities began to show themselves while he was still an undergraduate at Cornell. There he assisted on the teaching staffs of the physics, mechanics and machine-design departments in his junior and senior years. He was elected to Tau Beta Pi—and was awarded the Sibley prize, symbol of the highest rating in engineering studies for two consecutive years.

Both he and his wife are currently members of the Cornell University Council, Mrs. Littlewood having graduated from Cornell in 1921. He is also a director of the Cornell Aeronautical Laboratories, has served several terms as a director of the Cornell Alumni Association, and is a past-president of the Cornell Society of Engineers.

He has outstandingly those qualities of mind and attitude which tag him as a leader of men and thoughts, among both those who have worked intimately with him and those who know him casually.

COUNCIL

Robert Cass

Completing the 1953-54 term as Councilors are C. A. Chayne, General Motors Corp.; W. S. Cowell, Wheel & Rim Co. of Canada, Ltd.; and J. L. S. Snead, Jr., Consolidated Freightways, Inc. B. B. Bachman, Autocar Div., White Motor Co. serves again as treasurer. D. P. Barnard, Standard Oil Co., (Indiana) and Robert Cass, White Motor Co., continue on the Council as past-presidents. All vice-presidents representing Activities are members of the Council. Shown below are the three new Councilors for 1954-55: W. C. Heath, Solar Aircraft Co.; John G. Holmstrom, Kenworth Motor Truck Corp.; and F. Glen Shoemaker, General Motors Corp.

C. A. Chayne

D. P. Barnard

B. B. Bachman

W. S. Cowell

J. L. S. Snead, Jr.

W. C. Heath (M '42) is Chief Engineer of the Design Engineering Division of Solar Aircraft Co. He has been with Solar since 1937 in various positions. He got his present title in 1942.

In World War I Heath spent four years in the Marine Corps, then worked for United Fruit Co. in Central America. When he returned to this country he worked on several construction projects while he studied civil engineering. During World War II, Solar loaned him to the Technical Industrial Intelligence Committee under the Joint Chiefs of Staff to investigate German industry.

He was chairman of SAE San Diego Section in 1950-51, general chairman of the 1952 SAE National Aeronautic Meeting in Los Angeles, and membership vice-chairman last year of the Aircraft Powerplant Activity Committee. He is a member of ASME, an associate fellow of IAS, and a registered professional engineer in California.

W. C. Heath

F. Glen Shoemaker

F. Glen Shoemaker (M '20) is Chief Engineer of General Motors' Detroit Diesel Engine Division plant in Wayne, Mich.—set up after the beginning of the Korean war to manufacture air-cooled engine generator sets for armored vehicles. He has been with GM since 1928, heading the diesel engine program from its start in the Research Laboratories Division through the founding of the Detroit Diesel Engine Division in 1937. He continued as Chief Engineer of this Division until the end of World War II when he became consulting engineer on all phases of the diesel engineering program.

After his graduation from the University of Illinois, he was a World War I instructor of airplane engines with the U. S. Army School of Military Aeronautics at Illinois. During the next ten years, he was experimental engineer for Buda Co.; did development work on aircraft engines and ignition systems for the Air Service Engineering Division at McCook Field, Dayton; and worked on design and development of aircooled engines for Franklin Mfg. Co.

John G. Holmstrom (M '30), Vice-President and General Manager of Kenworth Motor Truck Corp., joined the company while he was still in high school as an after-school employee. While he studied mechanical engineering at the University of Washington, he worked at Kenworth as helper, mechanic, then draftsman. He became Chief Engineer in 1928, Vice-President of Engineering in 1936, and in 1945 began his present position.

Holmstrom has had an important hand in many modern developments and improvements in Western over-the-highway truck transportation. He did much to bring custom-built on- and off-highway trucks to the transportation industry on a production line basis. He has traveled extensively over most of the world to make first-hand checks on Kenworth engineering features wherever the heavy-duty vehicles are in use.

He was an early member of SAE Northwest Section, and its chairman in 1934-35.

John G. Holmstrom

R. W. Rummel — Vice-President, Air Transport

R. W. Rummel (M '38) has been with Trans World Airlines for 10 years and is now Chief Engineer. He started his career, after graduating from the Curtiss-Wright Technical Institute of Aeronautics, as an engineer with Hughes, Lockheed, then other aircraft manufacturers. Afterwards, as chief engineer of Rearwin Aircraft Engines, Inc. and Ken Royce Aircraft Co., he was responsible for the design and development of several light airplanes and aircraft engine models.

Rummel has long been active in aviation affairs, particularly and more recently in the airline field. He has held chairmanships of IATA and SAE committees, and has served on the NACA Subcommittee on Aircraft Loads and the National Security Resources Board Air Transport Mobilization Survey Group. He has written a number of papers for SAE and other societies.

Frank W. Fink — Vice-President, Aircraft

Frank W. Fink (M '44) is Chief Engineer of Consolidated Vultee Aircraft Corp. in San Diego, a position he has held since 1945. In his 18 years with Convair he has been designer, aerodynamicist, group engineer, assistant project engineer on the Model 31 two-engine flying boat, project engineer on the B-24 Liberator, and chief production engineer.

His first position, after he got his B.S. in mechanical engineering from University of Colorado, was with Curtiss Airplane & Motor Co., as draftsman. Later he worked in aerodynamics, designing, and project engineering.

Fink is a past-councilor of SAE, past-chairman of SAE San Diego Section, was general chairman of the SAE National Aeronautic Meeting in Los Angeles in 1951, and meetings vice-chairman of the Aircraft Activity last year. He is a member of IAS.

Gaylord W. Newton — Vice-President, Aircraft Powerplant

Gaylord W. Newton (M '45) is Chief of ARO, Inc.'s Engine Test Facility at the Arnold Engineering Development Center. He has held this position since 1951. Before that he was with Boeing Airplane Co. as chief of the powerplant engineering staff unit and, in 1951, as special project engineer for preliminary design of new propeller turbine installations and for special research projects.

Newton got his B.S. in mechanical engineering at New York University in their Daniel Guggenheim School of Aeronautics, and his LL.B. from George Washington University. From 1929 until 1941 he was chief of the powerplant unit of the CAA's engineering division. He was an early glider pilot, and has held a private pilot's license since 1931.

He has been active on several NACA and AIA committees, serves on the CFR Aviation Fuels Division of the CRC, and is a member of IAS. He has presented many papers before ASME and SAE meetings.

Gordon M. Buehrig — Vice-President, Body

Gordon M. Buehrig (M '31) is Body Engineer for Special Product Division of the Ford Motor Co. He has been with the company since 1949.

He started his automotive career as an apprentice body builder in 1925, with a company building bodies for Wills St. Claire, Jewett, and Peerless automobiles. He went from body building to engineering, and after several years of body drafting transferred to design and styling work.

Buehrig is well known for the custom bodies he designed when he was chief body designer for Duesenberg, and for the 810 Cord and the Auburn Speedster designs he created as director of the design department at Auburn Auto.

He has served on the Body Activity Committee for four years, last year as meetings vice-chairman.

COUNCIL

John Dickson — Vice-President, Diesel Engine

John Dickson (M '32) is Chief Design and Development Engineer with General Motors Corp.'s Detroit Diesel Engine Division. He has been associated with the design and manufacture of diesel engines for 35 years.

Dickson was born in Scotland and served his apprenticeship with A&J Inglis in Glasgow, and graduated from the Royal Technical College. He was on the design staffs of the North British Diesel Engine Works and the William Beardmore Co., representing Beardmore for two years in Canada on tests of Canadian National's Diesel Locomotive 9000. He came to the United States in 1930 as chief engineer of the diesel electric division of Westinghouse Electric Co. In 1936 he was with Hooven Owens Rentchler in Hamilton, Ohio, and from 1938 to 1950 was chief engineer in charge of new development at the Detroit Diesel Engine Division, with appointment to his present position in 1950. He became a United States citizen in 1935.

Alfred L. Boegehold — Vice-President, Engineering Materials

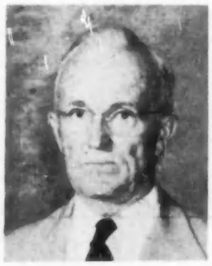
Alfred L. Boegehold (M '44) is Assistant to the General Manager of GMC's Research Laboratories Division, a position he has held since early 1952. He graduated from Cornell University with a mechanical engineering degree, then worked with Remington Arms & Ammunition Co., Bridgeport Brass Co., Remington Union Metallic Cartridge Corp., and U. S. Army Ordnance before joining the Research Laboratories Division. He was head of its metallurgy department for 27 years until he assumed his present position.

Boegehold held several Section and national offices in the ASM and was its president in 1947. He has written many papers for SAE and other technical societies since 1929, notable among them articles on Hardenability and Hardenability-Band Steels produced under the auspices of the SAE Iron & Steel Technical Committee.

Kenneth Boldt — Vice-President, Fuels & Lubricants

Kenneth Boldt (M '41) is Director of the engine and fuels research division of The Pure Oil Co. Research and Development Laboratories. He has been engaged in research and development for Pure Oil since he got his B.S. in chemistry from Elmhurst College in 1936, except for a year spent in the Armed Forces. In 1946 he became section supervisor of automotive and mechanical testing in the production development division. He began his present job in 1952.

Boldt has contributed to the technical committee work of both ASTM and CRC, and was meetings vice-chairman of the SAE Fuels and Lubricants Activity Committee last year. He has written several papers for SAE.



Harold Nutt — Vice-President, Passenger Car

Harold Nutt (M '19) is Vice-President and Assistant General Manager, and Director of Engineering, of Borg-Warner Corp.'s Borg & Beck Division.

He went to work for the B. F. Sturtevant Co. immediately after graduating from Worcester Polytechnic Institute in 1916. He started as an assembler and tester of gasoline engines, and soon advanced to assistant chief engineer. When Sturtevant discontinued gas engine production, he joined the railway motor car department of Fairbanks, Morse & Co. as designer. A year later he became assistant chief engineer of Premier Motor Co., working on chassis and engine design.

His next position, when Premier closed in 1922, was with Durant Motors, where he rose from engineer to chief engineer. He joined Borg & Beck in 1930 as director of engineering, was made vice-president in 1946, and added his current titles in 1953. He is a past-chairman of SAE Chicago Section, and a member of Tau Beta Pi and Sigma Xi.

Edward D. Kemble — Vice-President, Production

Edward D. Kemble (M '43) has been Manager—Manufacturing of the Air Conditioning Division of General Electric Co. since 1951. He joined the division two years before that as plant manager of the automatic heating plant.

Kemble got his B.S. in mechanical engineering from Case Institute of Technology, then held a variety of manufacturing positions—as foreman, as superintendent, in industrial engineering and in production control—in the automotive and container industries. He was works manager of the Cleveland Automatic Machine Co. during World War II, and plant manager of Clark Equipment Co.'s industrial truck division afterwards.

He has been a member of the Production Activity Committee for a number of years. During his term as meetings vice-chairman in 1953, the Production Activity sponsored more forums and meetings than ever before.

Harold L. Brock — Vice-President, Tractor & Farm Machinery

Harold L. Brock (M '44) is Chief Tractor Engineer in charge of Ford Motor Co.'s tractor engineering department. He joined Ford in 1930 as a student-apprentice, and after graduating from Ford Trade and Engineering Schools attended Detroit Institute of Technology. He joined Ford's engineering division in 1933 as detailer and specification writer, and was given his present assignment in 1940.

In 1941 he was assigned to Army Ordnance at Aberdeen Proving Ground to assist in the design of the M4 Sherman tank. When the design was complete, he helped develop and put the vehicle into production.

Brock has been a member of the SAE Tractor Technical Committee for several years.

Howard L. Willett, Jr. — Vice-President, Transportation & Maintenance

A third generation trucker, Howard L. Willett, Jr. (M '35) is Executive Vice-President of The Willett Company and President of its affiliate, The Willett Truck Leasing Company.

He received his Ph.B from the University of Chicago, then attended the Harvard Graduate School of Business Administration and Harvard Graduate Engineering School, receiving an M.S. in 1932. During World War II, he served both as Chairman and member of many ODT and OPS Committees, and was head civilian automotive adviser for the 94th Infantry Division.

Willett is a Director of the Cartage Exchange of Chicago, and has done much committee and other work for the Local Cartage National Conference. As one of the founders of the National Truck Leasing System, he has held various offices in it, and is now President. He was chairman of SAE's T&M Activity Meetings Committee in 1947, and of its Membership Committee in 1949.

R. C. Wallace — Vice-President, Truck & Bus

R. C. (Bob) Wallace (M '35) is Executive Engineer for Diamond T Motor Car Co. After attending M.I.T., he entered the automotive industry in 1927 as a mechanic in the factory service department of Stutz Motor Car Co., from which he advanced to service manager in 1929. He joined Marmon-Herrington Co. three years later as service manager and project engineer, later becoming vice-president in charge of engineering and director. He joined Diamond T in 1947 as Executive Engineer.

During the War, he was engaged in design and production of military vehicles, including several different models and tanks, amphibious vehicles, and all-wheel-drive units.

Wallace was treasurer of the SAE Indiana Section for 10 years and chairman in 1945-46. Since going to Chicago he has served as T&B vice-chairman, treasurer, secretary, vice-chairman, and chairman (in 1952-53) of SAE Chicago Section. He is also a member of ASM.

Rust Hasn't A Chance . . . against modern protective

RUST is an enemy the automotive industry guards against during every phase of processing, storage, and shipping.

Chief weapons are corrosion inhibiting compounds in processing liquids, slushing compounds, and paper, and strippable films.

Rust can form overnight. So protection of all iron and steel parts begins early, usually in conjunction with some other procedure. Sheet metal arrives from the steel mills coated with a light oil containing corrosion inhibitors. Castings get a coat of paint or primer over surfaces that are not to be machined. The coolant sprayed over surfaces being machined contains one part corrosion inhibitor to 10 to 100 parts of water. Machined parts are cleaned to remove chips and dirt, then rinsed in water plus a little emulsified oil or 0.02–0.10% alkali cleaning compound, or inorganic nitrite or chromate. This rinse deposits a film effective against perspiration residue and humidity for normal handling and storage during brief shut-downs.

Inspectors checking parts for leaks add to the test water 0.25–0.5% alkali cleaning compound, sodium carbonate, tri-sodium phosphate or sodium metasilicate.

Most major assemblies—such as transmissions and engines—receive adequate protection during processing from testing or operational fluids. Others—specifically, wheel brake and master cylinder assemblies—require special handling. After cleaning to remove dirt chips, handling residues, and mineral oil traces, these assemblies are coated with a special preservative lubricant.

Protection of Temporary Stores

Parts held in temporary storage need protection for from a few days to several months. Sheet metal parts usually retain enough of the slushing compound applied for protection during processing to be safe in temporary storage. Sometimes it is necessary to recoat sheet metal parts with the oil-type slushing compounds where finishing operations have removed the coating. For prolonged storage, it is wise to recoat every two months.

Slushing compounds also serve to protect machined and highly finished parts (Figs. 1 and 2). It isn't always necessary to coat them all completely with the compound. A heavy coating on the top layers of parts stored in a metal skid box is often sufficient because usually only the top surfaces of the top layers corrode anyway. Of course, wood or paper separators used in the box must be completely dry.

Large parts stored individually and protected with slushing compound should be coated all over.

Another way to protect parts is to pack them with volatile-corrosion-inhibitor impregnated paper. The inhibitor's molecules are polar. When they sublime on the part, one end of the molecule wets the metal preferentially, displacing any water already there. The other end is hydrophobic, barring water from penetrating the film.

Layers of impregnated paper interspersed with layers of parts in skid boxes have given satisfactory protection for 1½ to 2 years and even longer. No part should be more than 12 in. away from impregnated paper. Big parts and assemblies can be wrapped individually in the paper.

Combustion chambers usually have a corrosion inhibitor sprayed or poured in before they go into temporary storage. Other engine internal surfaces get sufficient protection from run-in oil. So do transmissions and most other assemblies.

Protection Between Plants

Protection for temporary storage is usually adequate for interplant shipment. However, for a few parts whose surfaces require physical as well as corrosion protection, strippable films are economically justifiable. Fig. 3 shows coated steering knuckles.

Three types of strippable films are in use. One type is formulated from vinyl resins in a suitable solvent and sprayed onto parts. Films over 0.002 in. thick peal off easily.

Of the other two types of strippable films, one is formulated from ethylcellulose and the other from

methods to form during processing, shipping, and storage of vehicle parts.

Carl O. Durbin, Materials Engineer, Chrysler Corp.

Based on paper "Corrosion Protection During Processing, Storage, and Shipment—Automotive Application" presented at SAE Summer Meeting, Atlantic City, June 8, 1953.

cellulose acetate butyrate. These compounds are heated to 325-375 F, at which they are molten. Then parts are dipped. The resulting coating is 0.08-0.10 in. thick. Because of the thickness of the films and the cost of the material, the process is usually economic only in applications where the films removed from parts can be re-melted and used again.

Protection for Service Storage

Parts for service are usually protected to withstand 10 years of storage. Many parts require no more protection for service storage than for temporary storage. Others, like highly finished engine parts, need application of a slushing compound.

The simplest way is to coat the part with a hard wax-type slushing compound in a solvent solution at room temperature or with a molten wax slushing compound. Preservative compounds having consistencies in the ranges of petrolatum may also be used if the parts are packaged in greaseproof paper.

Of course, dirt can embed in the wax or petrolatum compounds. So unless parts are wrapped or packaged, they should be cleaned before using. Wax or petrolatum preservatives must be removed also from assemblies requiring lubricants with

Slushing Compounds Protect Parts for Temporary Storage

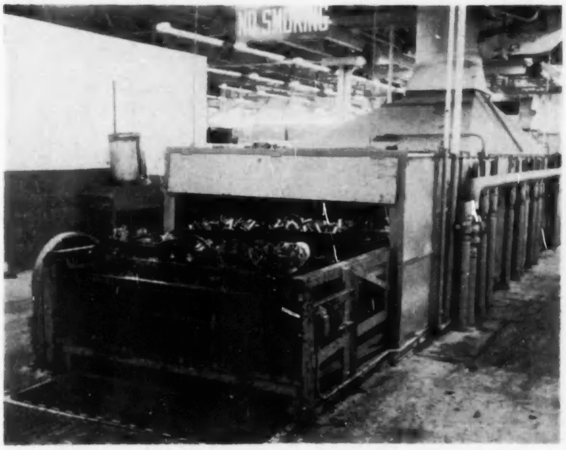


Fig. 1—Automotive parts come out of a machine that applies a wax-type slushing compound

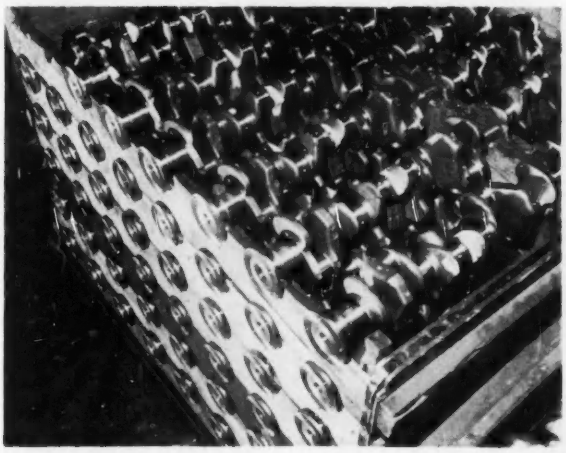


Fig. 2—Crankshafts coated with a light oil-type slushing compound are stacked in dry wood racks for storage in a temporary bank

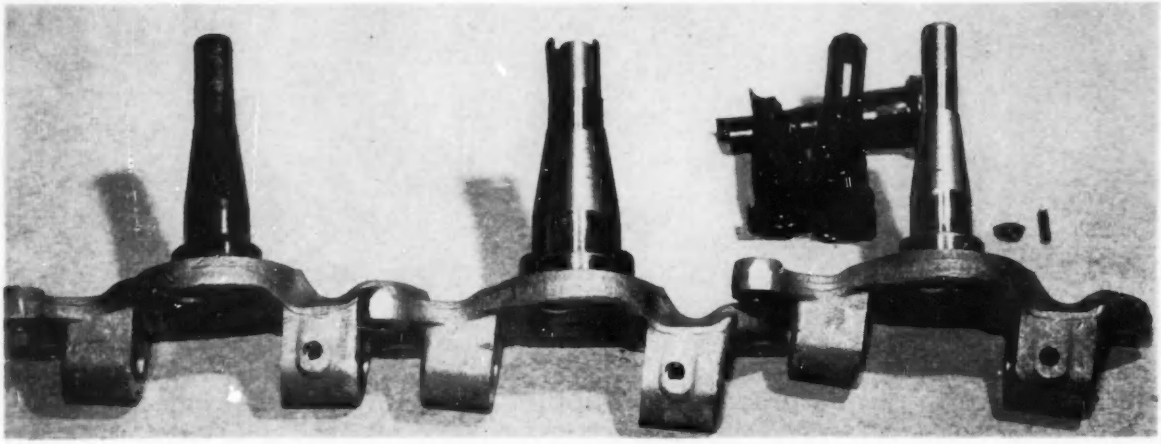


Fig. 3—Steering knuckles are coated with plastic strippable film. This coating replaces three chipboard tubes formerly required for mechanical protection

special low-temperature properties.

Many assemblies are protected by a coating of run-in oil or oil-type slushing compound inside, plugs over their openings, oil-type or wax-type slushing compound outside, and wrappings of vapor-corrosion-inhibitor paper. In some cases, the paper alone is enough to take care of parts that retain preservatives applied for protection during processing, temporary storage, or interplant shipment.

The packaging that identifies and protects small parts may be fiberboard cartons, greaseproof envelopes, or waterproof containers made of polyethylene-coated paper, scrim-foil-laminates, or metal foil. Sometimes combinations of these packagings are used. Fig. 4 shows the packaging of oil seals in polyethylene-coated kraft bags for service storage.

Fig. 5 pictures a crankshaft in its packaging for service storage. The crankshaft nestles in corrosion-inhibitor paper within a carton reinforced at the ends with dry wood.

Protection for Overseas Shipment

Cars shipped overseas knocked down go in units of six, 12, or 24 cars in a series of boxes. One box will contain all the sheet metal parts; another will contain all the engines. Tops and sides of each box are lined with waterproof paper to supplement the protection given to individual parts. Figs. 6, 7, and 8 show 12-unit export packs of various parts.

Sheet metal parts may be shipped with corrosion-inhibitor paper between layers of parts so that no surface is more than 12 in. away from the paper. Or the parts may receive a hard resin-wax-solvent slushing compound applied by brushing or spraying.

The advantage of corrosion-inhibitor paper is that it leaves parts clean. Slushing compounds have to be cleaned off surfaces that are to be painted. But

Service Stores Get Corrosion Protection

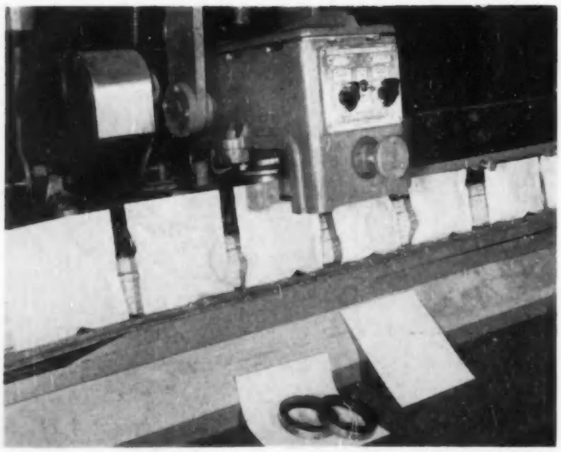


Fig. 4—Oil seals are coated with a light oil-type slushing compound and enclosed in heat sealable polyethylene-coated kraft bags. Sealing is done by this machine

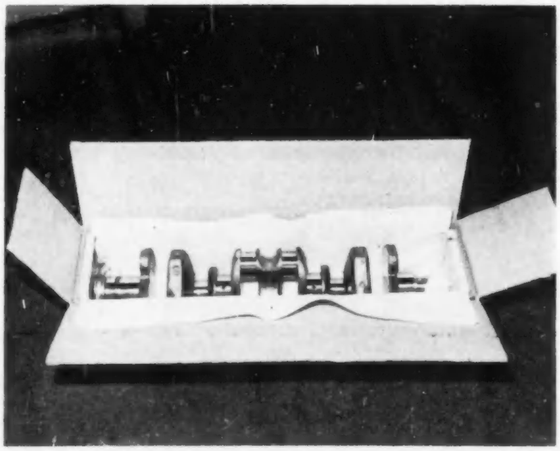


Fig. 5—Crankshafts for service storage are packed in cartons reinforced at the ends with dry wood and lined with corrosion-inhibitor impregnated paper

they have the advantage of giving protection before boxing and after unpacking.

Combustion chambers are protected for overseas shipment with corrosion inhibitors applied through the spark plug openings, just as they are for service shipment. When clutch assemblies are attached to engines, they are blocked in the disengaged position to prevent sticking. Electrical accessories travel in waterproof paper. Chassis parts, except brake drums, get coatings of the softer slushing compounds. Because brake linings are sensitive to petroleum products, brake drums are usually protected with lacquer coatings which burn off when brakes are applied.

On cars shipped built up, only engines and bright metal trim are given additional protection. The combustion chambers of engines are protected by 8 oz of an oil-type preservative poured through the carburetor while the engine is running. This is called "smoking." Bumpers, guards, radiator grilles, moldings, head lamp doors, and other bright metal parts are coated with a fast-drying petroleum resin or with a wax coating. Usually wax emulsions give better protection than paste or liquid waxes. Whatever is used must be removable with solvent which will not affect color lacquers or paints.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Parts Nest Neatly and Safely in 12-Unit Export Pack

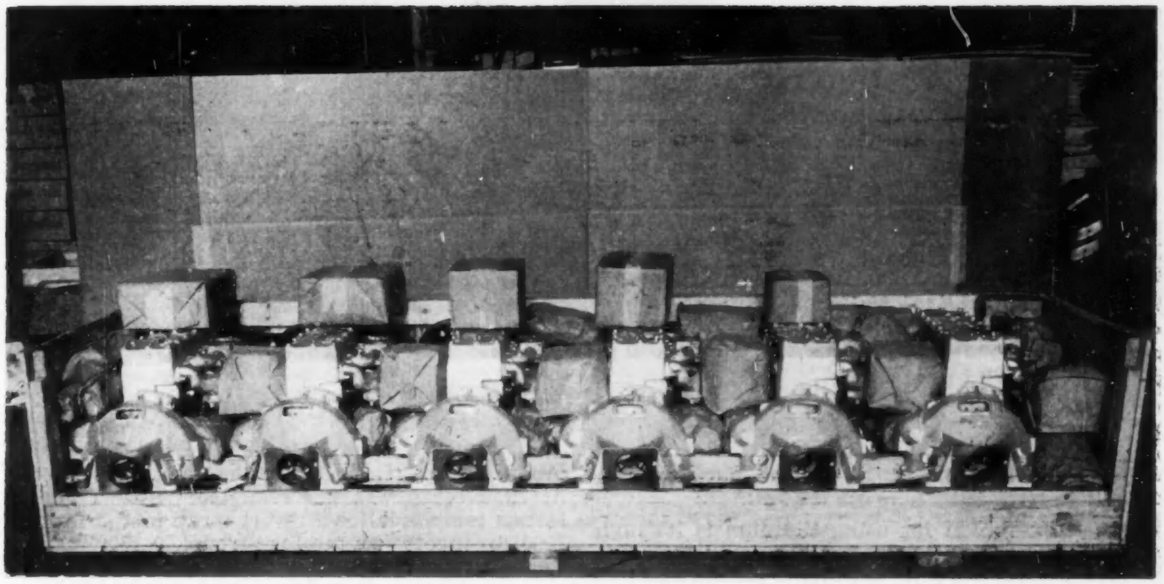


Fig. 6—Six engines travel together in this engine export box. Each 12-unit shipment contains two engine boxes like this

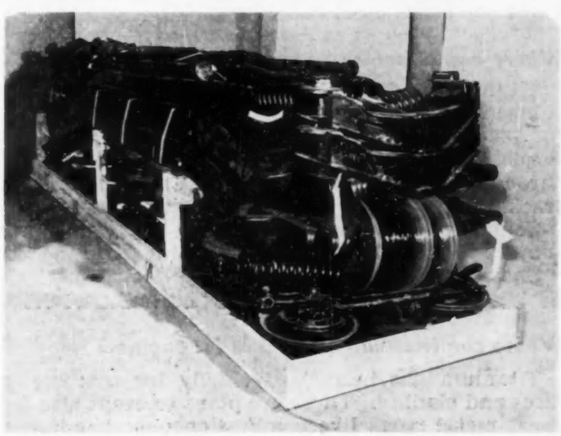


Fig. 7—Frames and chassis parts are lacquered or otherwise protected against corrosion and shipped this way

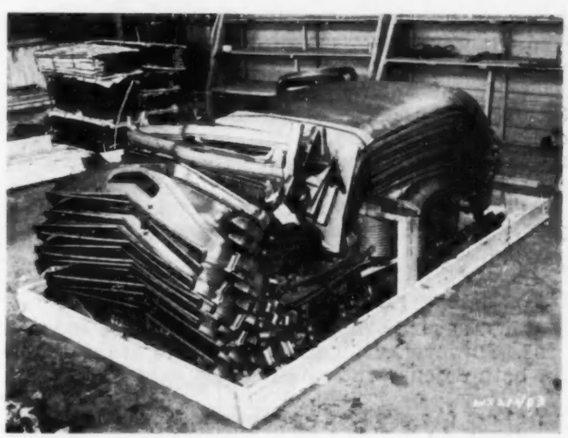
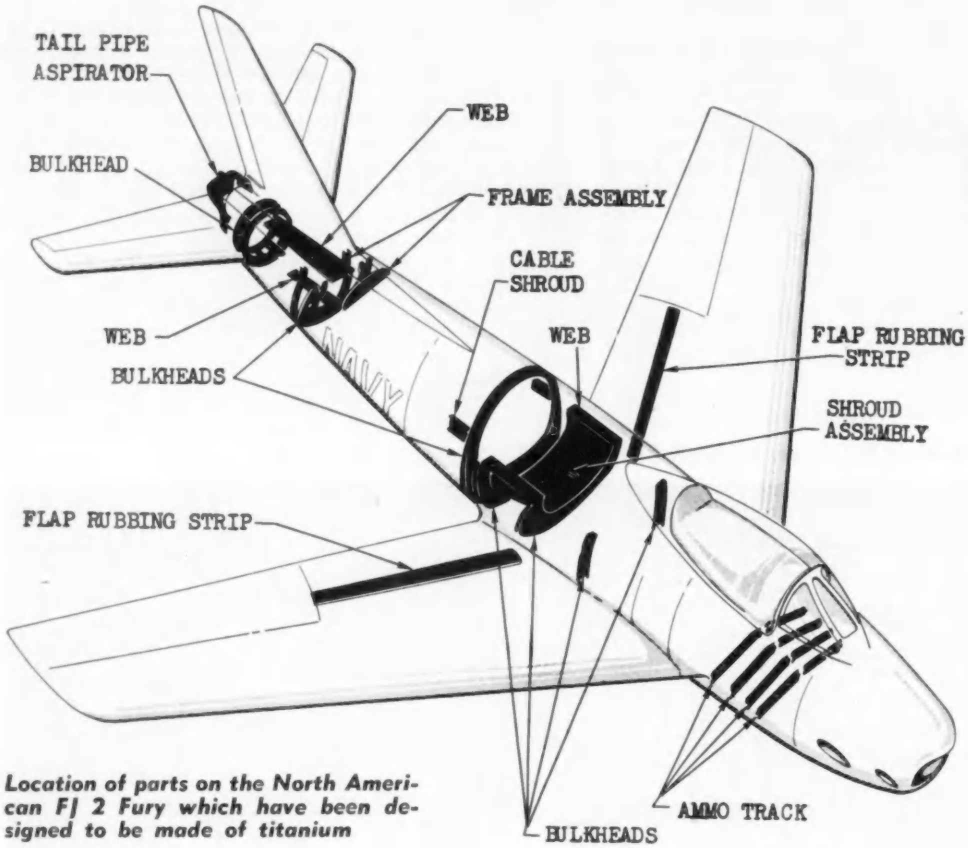


Fig. 8—Roof panels and miscellaneous sheet metal parts are coated with hard-film slushing compound, then nested for 12-unit shipment



New

Location of parts on the North American FJ 2 Fury which have been designed to be made of titanium

If titanium is so expensive and so much trouble to work with, why use it at all?

The main reason for using titanium is its high strength/weight ratio. Tests Allison made on compressor wheels illustrate titanium's advantages: in aluminum, the wheel weighed 25 lb and burst at 20,000 rpm; in stainless steel, it weighed 30 lb and burst at 17,000 rpm; in Rem-Cru 130-B titanium alloy, it weighed 17 lb and went up to 25,000 rpm without bursting.

Each pound of weight saved in the engine saves 8 to 10 lb in the rest of the airplane. Each pound of weight saved in the airframe lowers the gyroscopic effects and makes the plane more maneuverable.

Another reason for using titanium is that we have plenty available within our own boundaries.

How scarce is titanium going to be during the next few years?

It looks as if titanium is going to be tight through 1956. However, evaluation quantities are available for both defense and non-defense items.

What are the chances for a price reduction on titanium?

Price may go down early next year after sponge production increases and more scrap is remelted. At first, scrap was not remelted. Now Titanium Metals remelts its own revert scrap in the form of 1000-lb ingots containing from 70–100% scrap. Rem-Cru incorporates up to 10% remelt material in regular production. Both suppliers hope to increase use of remelt material. The more scrap used, the lower the price, users can expect.

Where can titanium be used in airframes?

Titanium and its alloys are being used in parts subjected to service temperatures around 250 F. RC 130-A alloy goes into fuselage frames and bulkheads. Commercially pure titanium goes into shroud assemblies, cable shrouds, and ammunition tracks.

Commercially pure titanium also goes into parts subject to corrosion, like flap-rubbing strips.

Shown above are parts on the North American FJ 2 Fury designed to be made of titanium.

Where can titanium be used in jet engines?

Titanium has been used chiefly for compressor discs and blading. There are plans to use it also for sheet metal parts like combustion chamber liners. Liners require 120,000 psi yield strength at room temperature and 60,000 psi at 600 F. An experi-

Techniques Tame Titanium

Robert Jaffee, Battelle Memorial Institute

Based on secretary's report of Panel on Titanium held as part of the SAE Aeronautic Production Forum at the SAE National Aeronautic Meeting, New York, April 20, 1953. Leader was W. L. Finlay, Rem-Cru Titanium, Inc.

mental all-alpha titanium alloy, Rem-Cru's RC A-110, which went into pilot production last spring, meets the strength requirements and is ductile in the welded condition. Earlier alloys were too brittle after welding.

What about all-alpha alloys?

The first all-alpha alloy on the industrial horizon is RC A-110. It is the titanium-aluminum base alloy, RC A-110. Its room temperature yield strength is moderate, 110,000 psi, but useful strength remains up to 1000–1200 F. (Strength of alpha-beta and beta alloys drops off at 800–900 F.)

The all-alpha alloy is ductile after welding. But sheet fabricability is not so good as with alpha-beta alloy, and all-alpha sheet needs to be heated to 600–900 F for fabrication operations. Minimum bend radius is 4 or 5 times thickness. Also the all-alpha alloy won't roll so thin as the alpha-beta. Sheets 1/16 in. thick and 36 in. wide are about the best we can achieve at present.

How about the reputed poor oxidation resistance of titanium alloys above 800 F?

Titanium has good oxidation resistance up to at least 1300 F. Strength—not surface stability—sets service temperature ceilings for titanium.

Titanium scales fairly rapidly at forging temperatures, but it can be fabricated without excessive contamination. Titanium performed excellently in the CAA 2200 F, 30-minute flame test.

What are the characteristics of titanium's creep strength?

The creep strength (based on second-stage rate less than 0.0001% per hour) of titanium is considerably lower than the yield strength at room temperature. But at temperatures from 200 to 500 F, creep strength is actually higher than yield strength. At still higher temperatures, creep strength drops below yield strength again.

Thus, whether creep strength or yield strength should be used for design depends on service temperatures. Westinghouse, for example, designs for 200–600 F service from the 0.2% offset yield strength. No growth has been noted in compressor blades so designed.

What about the reported poor notched-fatigue properties of titanium?

The reaction of parts subjected to alternating stresses is not so unfavorable as was at first feared. Early fatigue tests that showed poor results were made on very sharply notched specimens. Later tests using standard ASTM notches show much higher results. Notched RC 130-B tested at room temperature and subzero temperatures had endur-

On the panel which provided most of these answers were:

W. L. Finlay, Panel leader
Rem-Cru Titanium, Inc.

Robert Jaffee, Panel secretary
Battelle Memorial Institute

R. J. Bullock
Wyman-Gordon Co.

W. S. Hazelton
Westinghouse Electric Corp.

L. D. Jaffe
Watertown Arsenal Laboratory

Paul Maynard
North American Aviation Corp.

ance limits of about half those of unnotched specimens. The unnotched specimens had endurance limits of about 70% of tensile strength.

Is it still difficult to obtain sound ingots for forging?

No. In contrast to early experience, current ingots are sound and reasonably homogeneous.

What is the effect of the interstitial elements on forgeability?

In general, the interstitials in typical contaminant quantities do not affect forgeability adversely. They may, however, be deleterious to the room-temperature and low-temperature mechanical properties.

How much embrittlement is caused by heating titanium in air to forging temperature?

A short time at forging temperature causes only slight surface contamination, and this is removed by grinding or machining 0.002–0.010 in. from the surface. A preheat furnace at 1400 F minimizes time at high temperature.

Why not use induction heating?

Some bolt manufacturers use induction for upsetting. Induction heating looks like a good idea for heating ingots to forging temperature, because of the rapid heating rate.

Sheet Fabrication

Is warm forming better than cold forming?

For alloy sheet, the trend is definitely toward brake bending and hydropress forming with the work preheated to 600–900 F. The lower temperature is used if the forming is not severe. Unalloyed titanium parts can be formed cold, but for sharp bends, warm forming is recommended for pure titanium too.

Why are parts refrigerated before stretch forming?

The spread between yield and ultimate increases, and the amount of uniform elongation increases as temperature goes down. Therefore, some experimental stretch forming was done at subzero temperatures. Production stretch forming is done at room temperature.

How much springback is experienced?

About 12–13 deg at room temperature, but only 4–6 deg at 800 F.

What are the chief troubles in sheet fabrication?

Wrinkling of thin sheet causes trouble in deep drawing. Also, titanium does not shrink well. Where parts have to be shrunk, as in internal flanges, it is necessary to grasp the metal and upset it.

What bend radii are used in brake bending?

It has been found very desirable to deburr and polish the edges of sheet to be brake bent. This is done by draw filing. With the work warm and a bend radius of 3.5*T*, brake bending can be done with practically no scrap loss.

What about pressures in hydropress forming?

In hydropress operations, pressures around 1500 psi are used. If the work tends to wrinkle, the lower pressures are used.

How are blanks lubricated?

No lubricant is used in hydropress and rubber-pad forming. Punch-press forming is not used much but probably would require lubrication. Lubrication with molybdenum disulfide is used in stretch forming.

Is metal stamping satisfactory?

Most plants prohibit stamping of any kind because stress-corrosion cracking of stamped parts in acid has been noted.

What die temperatures are required for dimpling?

Dies heated to 750 F are used. The dimples formed at temperatures below 600 F are not well defined.

Welding

Are special welding chambers justified for titanium?

The use of a welding chamber filled with inert gas is justified in certain cases: First, for research investigations on welding or for learning how to weld titanium, an atmosphere chamber with rubber-glove inserts is extremely helpful. Second, for welding complex assemblies and fillet welding, where the shielding problem is difficult, welding in chambers is justified. One recent installation for welding titanium has an atmosphere room which the welder enters with suitable respiratory equipment. However, most production welding can be done in the open, using a gas-shielded arc, if proper precautions are taken.

What is the effect of post-weld heat-treatments?

Stabilizing-type anneals can improve the ductility of some alpha-beta alloy welds. In some alloys, such heat-treatment can be very effective. For example, using the post-weld heat-treatment (consisting of heating to 1350 F, furnace cooling to 1150 F, and water quenching) welds in Ti-2Mo-4Cr

alloy made with high-purity sponge can be improved from no ductility to 60% reduction in area and 40 ft-lb impact at room temperature. The strength of the weld metal so treated is 108,000 psi.

How pure must the welding atmosphere be?

The inert gas must be of high purity in order to obtain uncontaminated welds. Tolerances have not been completely established, but humidity must be less than 5%, nitrogen and oxygen less than 1%. (This is purity of the welding atmosphere—not that in the gas tank before welding.) Some argon was reported to be water pumped, a product to be avoided.

Can welded titanium be subsequently fabricated?

Yes. All welded titanium tubing is cold drawn, as much as 38% reduction in a single pass. Welded titanium must be flared hot, however.

Machining

What causes grinding cracks?

The causes are not known definitely. It is believed that alloys which are susceptible to heat-treatment are more prone to such cracking.

Are grinding cracks any more serious in titanium alloys than in steel?

Yes. Titanium alloys seem to be more prone to cracking, and more care needs to be taken to prevent cracking in grinding. Use of elevated-temperature grinding is helpful in avoiding cracking but not practical in all plants.

What machining operations are performed on a disc and what troubles are encountered?

The forged discs are turned, holes are drilled and reamed, grooves are broached, and flush grinding is used on the bearing. No serious machining problems are being encountered, but trouble still is being encountered with small holes less than 1/4 in. in diameter and with some milling operations. Broaching no longer gives trouble now that carbide insert broaches and carbon dioxide cooling have been adopted.

Tool life is no longer a problem. Carbide tools are required for machining the alloys. Roughing cuts are made at 40–65 sfm and finishing cuts at 125–250 sfm. For each disc, rough turning requires 12 hr and finish turning 27 hr. This is 20% more turning time than for an 18-8 stainless disc. A 200-lb forged disc ends up as a finished disc weighing around 50 lb. It is hoped to improve this.

How does machining of titanium alloys compare with machining of stainless?

Let's take a work-hardened 18-8 disc as a standard. A disc of Ti-Fe-Cr alloy (Ti-150A) is about as easy to machine, and one made of Ti-Al-Mn alloy (RC-130B) is slightly easier. The early difficulties were chiefly associated with alloys that had high carbon content. So long as the current alloys contain less than 0.25% carbon, they offer no particular difficulty. In machining bearing housings, which are thin walled, titanium alloys are preferred to 18-8 because they warp less.

Are there any developments in precision grinding?

In the investigation at Norton and MIT it was found that slow speeds of 1800–2500 sfm and additives like rust inhibitors (KNO_2) or soluble oils aided greatly. However, standard grinding equipment is set for speeds of about 6000 sfm, and the wheel manufacturers have wheels and coolants which work under these conditions. Dry grinding is definitely bad, and water cooling is almost as bad for efficient grinding. Snagging is usually done dry, however.

Heat-Treatment

What are the stabilizing heat-treatments of titanium alloys?

For alpha-beta alloys, the so-called stabilizing heat-treatments are used to render the alloys stable against hardening and embrittling during service at elevated temperature or as post-weld heat-treatments to eliminate transformation hardening as a result of rapid cooling from welding.

The principle behind stabilization is to perform the transformation of beta phase to massive alpha as completely as possible. This means that the transformation to massive alpha must be completed at as low a temperature as possible. Stabilization is accomplished by isothermal holding at 1100–1300 F or by initially heating at the higher temperatures to obtain an initial two-phase structure of massive alpha and unstable beta phases, and by slow cooling to 1000–1200 F to complete the transformation to massive alpha.

What can be done to harden titanium alloys by heat-treatment?

Quench-hardening heat-treatments appear to be out because of insufficient hardening and excessive embrittlement. Age-hardening heat-treatments based on instability of the beta phase offer good possibilities. The aging process must be kept under control, however. The most practical way to do this is through an alpha-beta solution treatment, through which the stability of the beta phase is unbalanced the proper amount, and then age hardening of the unstable beta-phase component at lower temperatures. These heat-treatments are in development, and it is not known how controllable they are from heat to heat. By next year practical benefits will probably be derived from such heat-treatments.

British Breed

BRITISH diesel-engine builders recognized some time ago that it takes a completely different breed of animal to power trucks on the North American continent. Thus, they set out to give the British species of diesel engine more power and a greater speed range to meet the road speed and gradeability needs of American truckers. And to make the job even more difficult for British engine designers, these ends had to be accomplished without unduly lowering the inherent high thermal efficiency of a diesel engine.

So, designers decided it would be a good idea to investigate the possibilities of supercharging. This they did, and found that exhaust-gas turbosupercharging seemed to have the most to offer. To better understand why, let's start from the beginning of the investigation.

A Roots-type mechanical blower was considered to be the simplest way to increase engine performance. But like many other simple mechanisms it had definite disadvantages. If it were permanently coupled to the engine, then energy was wasted when the engine was running at anything less than full load. This waste of energy under part load reduced the efficiency of the engine as a whole to the point where it was uneconomical compared with other types of high-performance engines.

Next, we tried to improve this part-load deficiency of Roots blowers by placing an air release after the compressor which would reduce the boost pressure ratio and, with it, the compressor input. Upon testing this arrangement, it was found that part-load fuel consumption at any engine speed was considerably reduced . . . and only slightly higher than that obtained with a naturally aspirated engine. Unfortunately, the governing device for the air release was not easily achieved. It entailed additional complication to the operating mechanism of the engine.

Following this, we developed a so-called two-speed mechanical supercharger (two speed-up

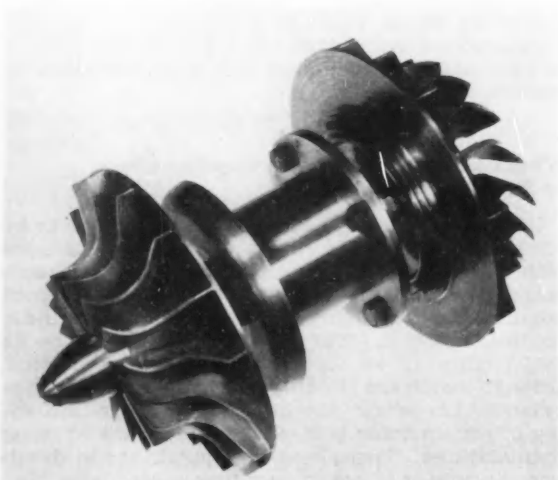


Fig. 1—This exhaust gas-driven turbosupercharger made a British diesel engine suitable for American trucks. Note that it has an inward flow centrifugal turbine and an outward flow centrifugal blower

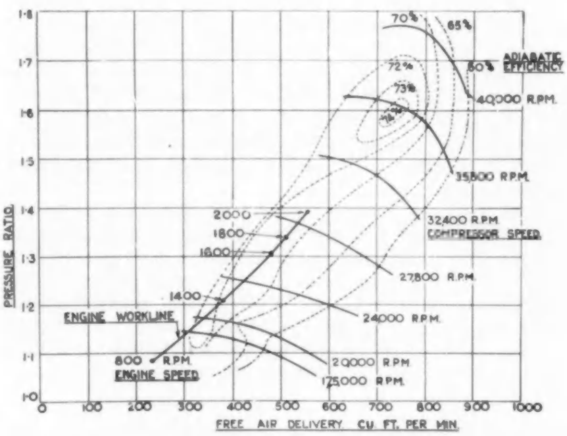


Fig. 2—This illustrates the excellent tailoring of the centrifugal compressor (See Fig. 1) to the workline of a 600 cu in. British diesel

an American Diesel

S. Markland and J. McHugh, Leyland Motors, Ltd.

Based on paper "Some Recent Notes on the Leyland Development of High-Speed Compression-Ignition Engines" presented at SAE International West Coast Meeting, Vancouver, Aug. 18, 1953.

ratios between engine and compressor). The high gear ratio was 2.3 to 1 engine speed, and was used up to approximately 1300 rpm engine speed. At 1300 rpm, low gear with a speed-up ratio of 1.67 to 1 took over. This arrangement was meant to produce a high supercharged pressure at low engine speed (high power and torque) . . . and normal supercharging at the higher engine speeds.

Results obtained with this "high torque ratio engine" were quite promising, but we were aware that they could only be achieved by relatively expensive complications.

Recognizing the limitations of mechanical supercharging, Leyland became interested in the possibilities of exhaust-gas turbocharging. Thus, in the late 1930's a turbocharged prime mover was developed in cooperation with Buchi, of Switzerland. With this unit it was possible to obtain a maximum power output of 180 hp from an engine of approximately 600 cu in. capacity.

The early Buchi blower, however, had one serious disadvantage. Since it was not coupled permanently to the engine, there was a time lag for the blower to attain maximum speed. At maximum

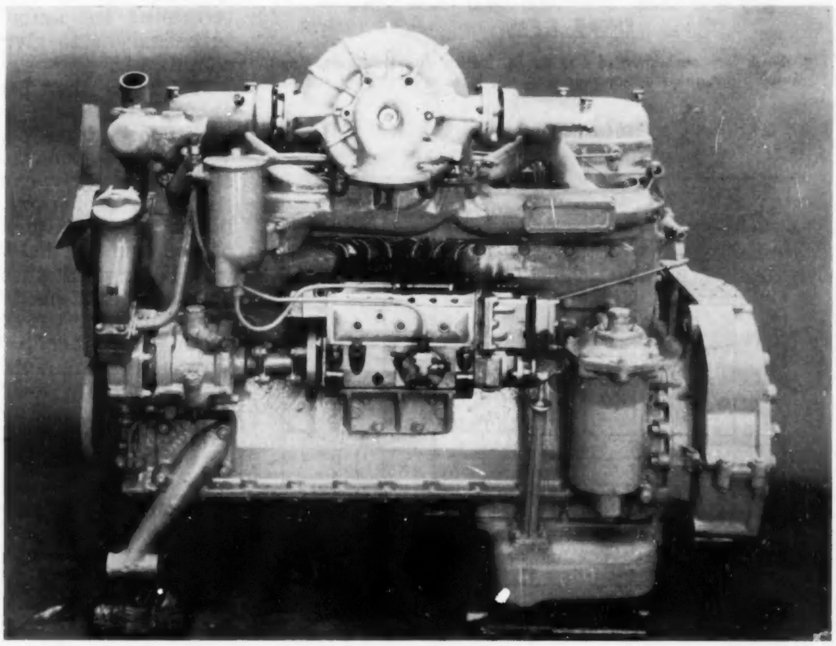


Fig. 3—The complete turbosupercharger weighs 52 lb. As can be seen, it adds little to the external dimensions of the engine

engine speed, about 21 sec elapsed before maximum supercharge could be obtained. This time delay naturally precluded use of such a supercharged engine in road vehicles.

While Leyland believed that this type of supercharger could be improved, it was not until some years after World War II (1949) that we could attempt it. Then, a supercharger was designed in which the inertia of the rotating parts was greatly reduced, and the general design simplified. The whole assembly was extremely light, with the result that the run-up time at maximum engine speed (to give full boost) was only about 3 sec. Thus, this turbocharger licked the time-lag problem and proved suitable for vehicle work, especially since it gave considerable boost at something less than full engine speed.

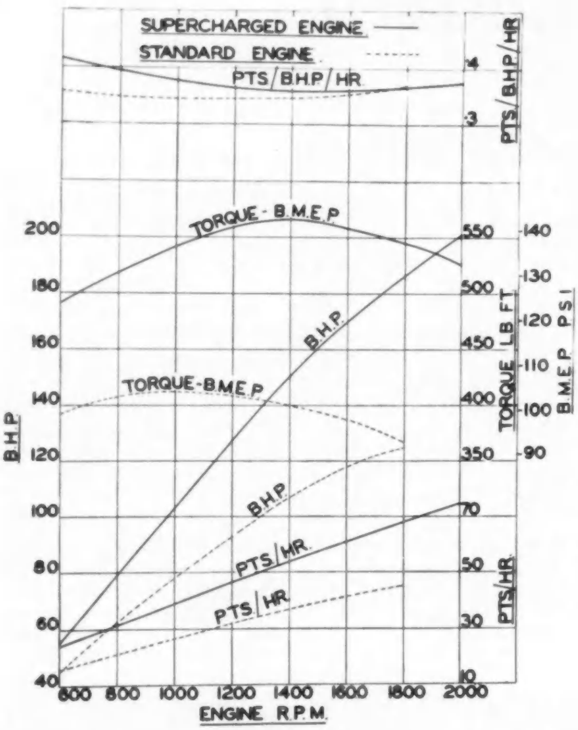


Fig. 4—A turbosupercharged 600 cu in. British diesel delivers almost 50% more maximum horsepower than the same engine when naturally aspirated

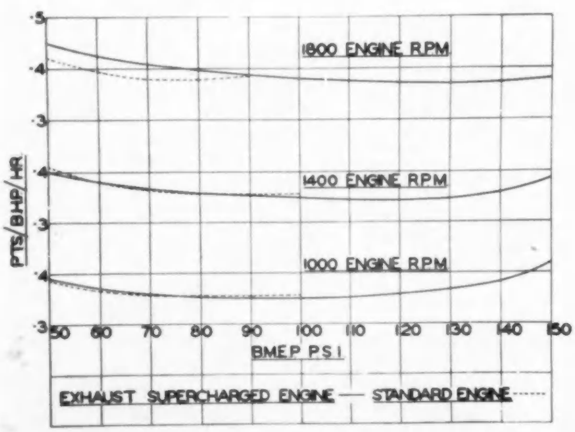


Fig. 5—Part-load fuel consumption for a turbosupercharged 600 cu in. British diesel and a naturally aspirated one

Now let's take a look at what it was like . . . and what it could do.

The main components were an exhaust-driven turbine of the inward flow centrifugal type and an outward flow centrifugal type compressor. Both units were coupled to a common shaft. Fig. 1 shows the complete rotor assembly, together with the bearing sleeve.

The results of tests with the centrifugal compressor are shown in Fig. 2. Note that the maximum adiabatic efficiency (74%) is obtained at a pressure ratio of 1.6. (This compares very favorably with the efficiency of a mechanical displacement blower.) The workline of the 600 cu in. engine shows that for all engine speeds, the highest compressor efficiency for the matched compressor speed is provided.

Fig. 3 shows the unit mounted on the 600 cu in. engine. The complete turbocharger weighs 52 lb and, in the position shown, adds little to the external dimensions of the engine.

Figs. 4 and 5 show the results obtained under full-load and part-load conditions from the turbocharger-equipped 600 cu in. engine. (For comparison purposes, similar curves for a naturally aspirated engine also are shown.) It can be seen that the turbocharger readily adjusts itself to engine load conditions. What's more thermal efficiency is maintained, or even improved, under certain load conditions. The net increase in maximum horsepower amounts to approximately 50%.

One of the problems that had to be resolved in tailoring the turbocharger to the engine was determining the amount of energy required by the turbocharger to give the desired boost to the incoming air.

We knew that by varying the opening of the exhaust valve, the amount of energy liberated to the turbocharger could be accurately determined. We realized, too, that if the exhaust valve were opened too early, extra boost would be obtained at the expense of losses in expansion ratio in the cylinder. This, in turn, might result in a reduction of the overall efficiency of the engine. Finally, it was recognized that if the exhaust valve were opened later a greater number of expansions would be possible, but the energy to drive the turbocharger would be reduced. Therefore, a compromise was arranged wherein the exhaust valve was opened at a point which would give about the supercharge required, yet still maintain the highest possible engine thermal efficiency.

Last, but far from least, it was necessary to find ways to disperse the additional heat generated so that such vital parts as pistons, rings, and cylinders would not suffer heat failures.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Investigations of PREIGNITION Are Bringing Results

THE term "preignition" is used very loosely to describe all types of uncontrolled combustion other than knock. This usage seems to be responsible for the wide differences of opinion among these authors as to what name or names to give to the phenomena they were investigating.

Melby et al said, for example, that they investigated "preignition," and identified four types: silent preignition, steady preignition with noise, autoignition, and wild ping. Their investigations showed that "preignition" is caused mainly by deposits, which, under certain conditions, become hot enough to ignite the mixture prior to ignition by the spark.

On the other hand, Hirschler et al used the expression "deposit-induced ignition," which they defined as the erratic ignition of deposits to produce uncontrolled combustion, noticeable as: autoignition, wild ping, preignition, and engine roughness.

Winch said he did not favor a strict definition of the many types of abnormal combustion because most of the techniques developed so far are only able to indicate that something abnormal has occurred—without being able to distinguish exactly what the character of the abnormality is. He offered as a general definition of preignition, "the ignition of a flame front by some means other than spark discharge at some point in the combustion chamber prior to the arrival of the normal flame front at that point." Knock does not fit this definition because it does not conform to conventional flame-front combustion. Wild ping, he believes, is a combination of preignition and knock.

Finally, Williams-Landis used the term "uncontrolled combustion," which is also favored by Heron to cover all forms of ignition of the charge that are not the direct result of the spark. Like Winch, Williams-Landis did not try to distinguish the various forms of uncontrolled combustion in their tests. They used the term "autoignition" to cover all types of disordered combustion other than knock.

Next, it is to be noted that no two investigators used exactly the same test procedures, although Winch, Melby et al, and Hirschler et al all used an ionization gap in their setups. Melby et al used the

THIS article is based on a group of papers presented as a "Symposium on Preignition."

Titles and authors are:

Uncontrolled Combustion in Spark-Ignition Engines—A Note
by S. D. Heron
Ethyl Corp.

An Investigation of Preignition in Engines
by A. O. Melby, D. R. Diggs, and B. M. Sturgis
E. I. du Pont de Nemours & Co., Inc.

Deposit-Induced Ignition Evaluation in a Laboratory Engine
by D. A. Hirschler, J. D. McCullough, and C. A. Hall
Ethyl Corp.

Some Effects of Fuels and Lubricants On Autoignition in Cars on the Road
by R. K. Williams and J. R. Landis
GMC Research Laboratories Division

The Occurrence of Preignition in Present-Day Cars in Normal Service
by R. F. Winch
Sun Oil Co.

These papers were presented at the SAE Summer Meeting, Atlantic City, June 10, 1953.

These papers are available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ each to members, 50¢ each to nonmembers. These papers will also appear in full, with discussion, in the 1954 SAE Transactions.

ionization gap in conjunction with a rate of change of pressure pickup, the signal from which was observed on an oscilloscope screen, and an electronic counter, which was used to count the number of times preignition occurred. Hirschler et al also used a counting mechanism.

Williams-Landis measured "autoignition tendency" in terms of octane number. It was determined by testing the vehicle in a prescribed manner using reference fuels of progressively higher antiknock quality until two successive fuels were found: one giving autoignition at some point during the test sequence and the other giving autoignition-free operation during the entire test.

The work of Melby et al covers chiefly the effects of engine operating conditions. Fuel and oil factors were studied by both Hirschler et al and Williams-Landis. Winch investigated preignition tendency in 1952 and 1953 car engines in normal service, and also the relation of preignition to knock.

What follows are excerpts that give, for the most part, only the authors' results.

To introduce the research papers, a short quote from the Heron note is included, which gives his definition of "preignition."

One Definition of "Preignition" —S. D. Heron

PREIGNITION is neither a product of the atomic age nor only of the high-compression-ratio engine. Preignition is an old, if not well-known, disease of the Otto-cycle engine despite the thought in some quarters that it is a recently developed engine ill.

Preignition is a term which is currently applied to cover several varieties of uncontrolled combustion. The term is here used in the sense in which it has been understood by the aircraft-engine engineer for many years and meaning ignition of the charge occurring prior to the passage of the spark. Preignition as it is known in aircraft engines is almost always the result of ignition from a hot surface within the combustion chamber. It is almost always an unstable condition in that, once it starts, the surface causing ignition rises in temperature with each cycle and, as a result, ignition occurs progressively farther and farther down the compression stroke. Eventually, if the process proceeds, ignition will occur while the intake valve is still open and the engine will backfire. Preignition in aircraft engines is usually very destructive and dangerous. As a rule it causes seizing or melting of a piston. As a result of backfiring it can cause explosions and fires in the induction system.

It should be emphasized that preignition is mostly not audible and need not be preceded by knock. In many cases an engine will go out of normal combustion straight into violent and destructive preignition without the occurrence of audible phenomena. Knock, by increasing the temperature of surfaces within the combustion chamber, can cause preignition.

The passenger-car engineer is closer to destructive preignition than he probably realizes. Preignition is distinctly a disease of high engine speed, and high volumetric efficiency at high speed aggravates the disease. The current tendency to increase the high-speed volumetric efficiency of passenger-car engines with four barrel carburetors, and so on, will tend to promote destructive preignition. Such passenger-car engines still have to perform creditably in traffic and spark plugs consequently have to be reasonably hot. The plug that is adequate for traffic driving may be quite inadequate for high speeds on the open road. In this connection, the author is unable to visualize the American driver following the practice of the European owner of a hot-stuff sports car, who will willingly drive in traffic with "soft" plugs and change to "hard" plugs for the open road.

Effect of Engine Operating Conditions

—A. O. Melby, D. R. Diggs, and B. M. Sturgis

COMBUSTION-chamber deposits are the primary cause of preignition in modern automotive engines.

Deposit-induced preignition may be silent or it may be manifested by a variety of engine noises ranging from light pings to violent explosions.

The ability of deposits to induce preignition arises from localized high temperatures, which are developed through the combustion of carbonaceous material in the deposit structure.

The "burn-off" of carbonaceous material is promoted by the salts of lead and other metals and is influenced markedly by engine conditions. The occurrence of preignition is favored by changes in engine operating conditions (1) that result in the development of higher pressures and temperatures

during compression or (2) that cause an increase in the concentration of oxygen available to support the combustion of carbonaceous material.

Thus, the tendency for the occurrence of preignition is increased by:

1. Increased compression ratio.
2. Supercharging.
3. Operation with retarded spark timing.
4. Combustion of lean mixtures.

In order to investigate the interrelation of these factors, particle introduction-type experiments were conducted under a wide range of engine operating conditions. These conditions are summarized in Table 1.

For most experiments the engine was operated with spark ignition occurring at 5 deg btdc and with the electronic preignition counter adjusted to register whenever preignition occurred 5 deg or more before the normal spark or 10 deg btdc. The deposit particles which were used for studying the effects of engine operating conditions on preignition were scraped from the tops of the pistons of a 1949 passenger-car engine that had been operated in the laboratory for 200 hr. The fuel was a catalytically cracked distillate containing 3.0 ml of tetraethyl lead per gallon, and the lubricant, a compounded SAE 30 oil.

Compression Ratio—Increases in compression ratio favor the occurrence of preignition by producing higher pressures and temperatures during compression, which decrease the ignition energy requirements of the combustible mixture and increase the igniting potential of the particle. The latter effects result from an increase in both the temperature and the partial pressure of oxygen in the system.

The effect of compression ratio on the amount of preignition, caused by particles of engine deposits and of sugar carbon, is illustrated in Fig. 1. A fivefold increase in the number of preignitions induced by the engine deposits resulted when the compression ratio was increased from 5.4/1 to 6.8/1. The importance of increased compression ratio is indicated further by the behavior of carbon particles, which caused very little preignition at the lower compression ratio but appreciable preignition at the higher compression ratio.

Inlet Manifold Air Pressure—Increasing the inlet manifold air pressure caused increases in deposit preignition harm similar to those which resulted from increased compression ratio. Fig. 2 shows that the number of preignitions caused by engine deposit particles increased linearly as the manifold air pressure was increased from 30 to 65 in. Hg abs. It is believed that this increase can be attributed to an increase in the ignitability of the charge and the ratio of oxygen to carbonaceous material.

Spark Timing—Marked increases in the preignition harm of detached deposit particles occurred as spark timing was retarded. This is illustrated in Fig. 3, where the number of preignitions occurring 10 deg or more before spark are plotted against spark timing for inlet air temperatures of 160 F and 300 F.

The greater number of preignitions under retarded spark conditions may be explained by (1)

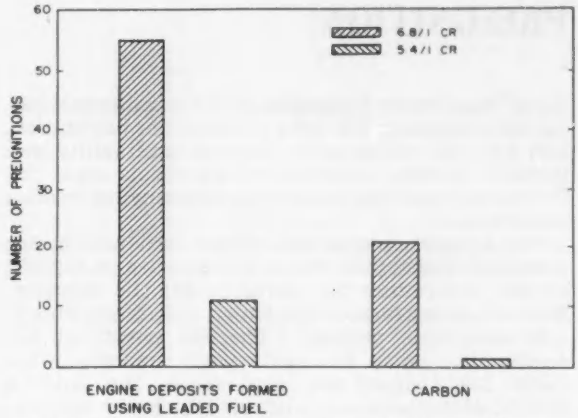


Fig. 1—Effect of compression ratio on preignition resulting from introduction of engine deposit particles and carbon. 40 in. Hg manifold air pressure, 300 F inlet air temperature, 12.5 air/fuel ratio, 5-deg btdc spark timing (from Melby et al)

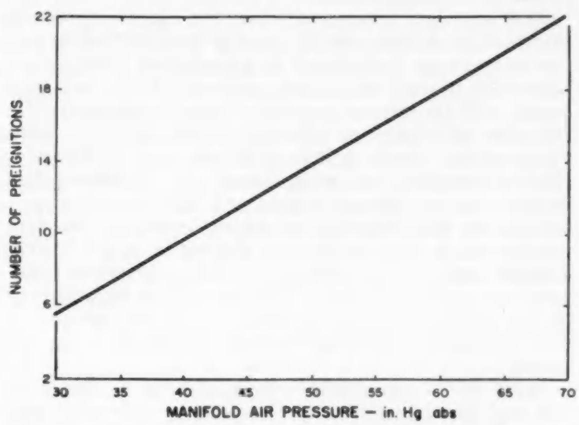


Fig. 2—Effect of manifold air pressure on preignition resulting from introduction of engine deposit particles. 300 F inlet air temperature, 12.5 air/fuel ratio, 5-deg btdc spark timing, 5.4/1 compression ratio (from Melby et al)

Table 1—C.O.T. Engine Operating Conditions for Studies of Deposit Preignition Harm

Fuel	Benzene
Fuel System Type	Manifold injection
Air/Fuel Ratio	Variable
Inlet Air Temperature, F	160 and 300
Manifold Air Pressure, in. Hg abs	30 to 65
Jacket Temperature, F	216
Oil Temperature, F	145
Compression Ratio	5.4/1 and 6.8/1
Engine Speed, rpm	2370
Spark Timing	Variable
Spark-Plug Type	Very cold

an increase in the temperature of the exhaust gases, (2) an increase in the time available for preignition, and (3) the increases in mixture ignitability and particle igniting potential which result from the increases in charge density accompanying further compression.

The temperature of the gaseous products in the combustion chamber during the power and exhaust strokes determines to a large extent the temperature of all surfaces with which the fresh charge will come into contact. Thermal effects of the combustion gases are particularly important because the temperature, and hence the igniting ability, of deposits and surfaces which are not participating in chemical reactions is determined entirely by the temperature of their environment. However, the temperature of deposits that are undergoing exothermic chemical reactions, such as are involved in the burn-off of carbonaceous material, is likely to be influenced by the combustion gases to a lesser extent.

The greater time available for particle-caused preignition as the spark timing was retarded was probably more important in promoting preignition than the higher temperature level of the exhaust gases. This longer contact time permitted the transfer of a greater amount of energy from particles to the combustible mixture, thus increasing the probability of preignition. In addition, the ignitability of the mixture and the igniting potential of the chemically active particles become greater with each additional degree of crank travel during compression because of the increase in temperature and pressure. The increased ignitability of the mixture is due in part to the occurrence of fuel oxidation reactions, which sensitize it to ignition.

Inlet Air Temperature—A moderate increase in the amount of preignition caused by particles was found to occur when the temperature of the inlet air was raised from 160 F to 300 F, as shown in Fig. 3. This effect was more pronounced with late spark timing than with more advanced ignition. The effects of changes in air temperature are less marked than might be expected. Increasing the inlet air temperature favors the occurrence of preignition by raising the operating temperature level, but at the same time decreases the charge density, which tends to reduce deposit preignition harm.

Air/Fuel Ratio—The introduction of engine deposit particles did not cause preignition under extremely rich mixture operating conditions, but as air/fuel ratio was increased, preignition occurred in increasing amounts. This effect is shown in Fig. 4.

Operation at lean mixtures increases the oxygen concentration in both the unburned and burned gases, increases the temperature level of the combustion chamber, and decreases the ignitability of the mixture. The increase in oxygen concentration is particularly important because oxygen must be available if carbon combustion, much of which is initiated at the time of charge combustion, is to be maintained during the power and exhaust strokes to the extent necessary to provide the temperatures requisite for preignition on subsequent compression strokes. During the intake and compression strokes the effects of increasing the air/fuel ratio on oxygen concentration are very small and probably negligible. After combustion and throughout the expansion and exhaust strokes, however, the oxygen concentration is much higher under lean than under rich mixture conditions since more of the oxygen remains after the combustion. Because of this, carbon burn-off is sustained and probably even promoted.

Some hydrocarbons have a greater tendency to be ignited by hot deposit particles than others. Preflame reactions of the fuel tend to sensitize it to ignition. Under certain conditions, the effect of these preflame reactions can be minimized by tetraethyl lead.

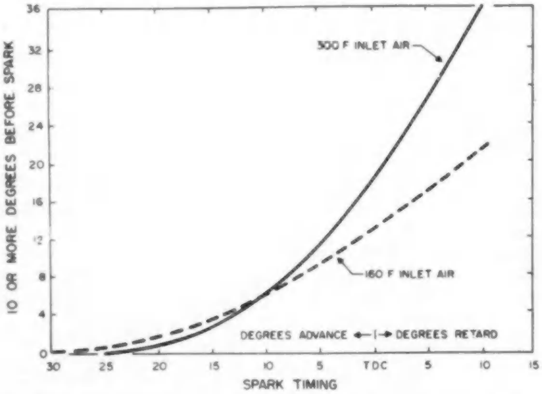


Fig. 3—Effect of spark timing and inlet air temperature on preignition resulting from introduction of engine deposit particles. 40 in. Hg manifold air pressure, 12.5 air/fuel ratio, 5.4/1 compression ratio (from Melby et al)

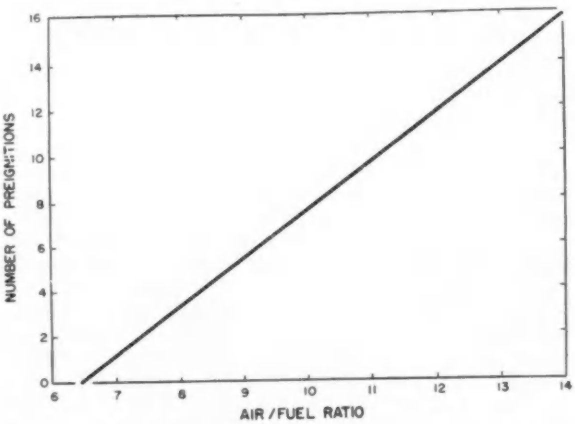


Fig. 4—Effect of air/fuel ratio on preignition resulting from introduction of engine deposit particles. 40 in. Hg manifold air pressure, 300 F inlet air temperature, 5-deg btdc spark timing, 5.4/1 compression ratio (from Melby et al)

Effect of Fuel and Oil Factors

—D. A. Hirschler, J. D. McCullough, and C. A. Hall

A USEFUL laboratory engine method has been developed for measuring deposit ignition (erratic ignition of the fuel-air mixture by combustion-chamber deposits). The method employs an ionization gap in the combustion chamber and electronic instrumentation which detects and records uncontrolled, deposit-ignited combustion. The method is superior to those previously used because it provides a continuous recording and is not dependent on audible effects, which do not always follow deposit ignition.

Laboratory investigations have been made to determine the effects of both fuel and oil factors.

Fuel Factors

It has been pointed out by several investigators that a wide variety of chemical materials found in engines, including lead compounds and metallic oxides, can lower the ignition temperature of certain forms of carbon and thereby promote its burning. This catalyzed burning of carbonaceous material in deposits may generate sufficient heat to produce ignition of the fuel-air mixture. Ignition caused by this type of deposit would then appear to depend on the type and amount of carbon produced by the fuel and oil as well as the presence of catalyzing materials. These latter materials may originate from compounds present in the fuel, oil, air, or from wear of engine parts.

The effect of tetraethyl lead was investigated in a mild, cycling-type laboratory test schedule in which efforts were made to minimize the presence of other catalytic materials. It was found that the effect of tel in promoting deposit ignition was highly dependent on base fuel type. For instance, the effect was very small in isooctane, quite large in toluene, and intermediate in commercial gasolines.

In examining the effects of fuel and oil composition, it was desirable to control the presence of the catalytic materials. Consequently, the studies were conducted with fuels containing 3 ml tel, and nonadditive lubricating oils, unless otherwise noted. Furthermore, the amount of contaminants in the intake air was minimized by passing the air through a water-spray chamber.

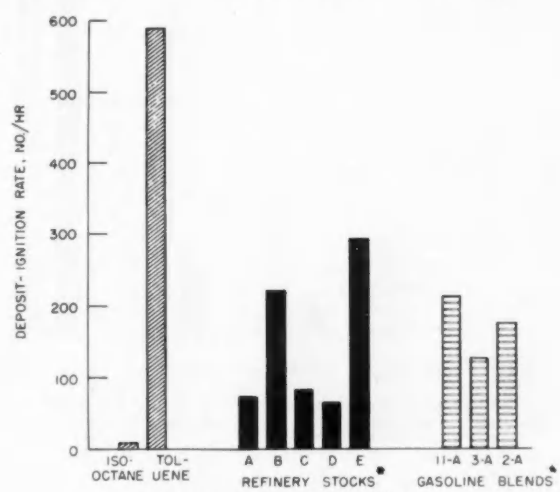
The carbonaceous materials originate from both the fuel and the lubricating oil. Consequently, fuel characteristics would be expected to have an important influence on the amount of deposit ignition. As a step toward determining the relative importance of several fuel characteristics, the effects of fuel volatility and hydrocarbon composition were examined.

Fuel Volatility and Composition—Several fuels were tested which were representative of different individual hydrocarbon types, and which had different volatilities. The aromatics, benzene and toluene, produced by far the highest rates of deposit ignition. In comparison, the olefins, paraffins, and naphthenes all gave relatively low rates of deposit ignition. Furthermore, within a given hydrocarbon class, there was a general tendency for higher-boiling materials to produce more deposit ignition.

The significance of heavy fuel components, as measured by volatility, was further investigated by distilling a catalytically cracked naphtha to three different end points: 360, 398, and 454 F. The amount of deposit ignition obtained with these fuels was found to decrease rapidly as the heavier portions of the fuel were removed. Since hydrocarbon-type proportions did not vary appreciably among these fuels of different end points, the effects observed appear to be due primarily to changes in volatility. It should be pointed out that, although this large effect of volatility has been investigated so far with only one gasoline stock, it is supported by the results with individual hydrocarbons. Since the effect is so marked, it represents an attractive field for further research with other gasoline stocks.

Comparison of Full-Boiling Gasolines—The large differences found among the hydrocarbon classes made it of interest to determine if differences among full-boiling fuels could be related to their hydrocarbon-type analyses. Three commercial gasoline blends, and five stocks produced by differ-

HYDROCARBON TYPE, %										
AROMATICS	0	100	5	31	35	35	42	21	27	28
OLEFINS	0	0	1	28	17	1	2	23	17	17
NAPHTHENES	0	0	8	12	17	2	12	13	16	18
PARAFFINS	100	0	86	29	31	62	44	43	41	37



* End points approximately 400 F

Fig. 5—Effect of different fuels on deposit ignition. Fuels contain 3 ml tel per gal (from Hirschler et al)

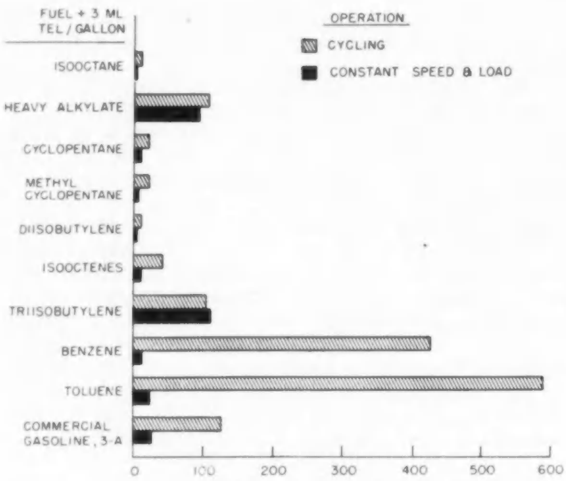


Fig. 6—Relative effects of constant speed and load versus cycling operation on deposit ignition of various fuels (from Hirschler et al)

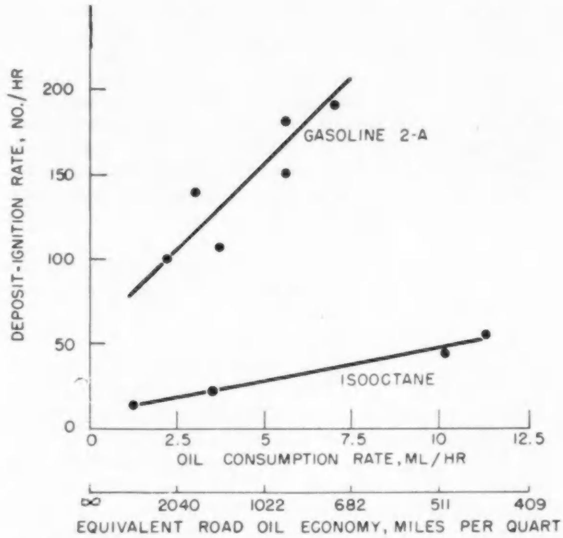


Fig. 7—Effect of oil consumption rate on deposit ignition. Oil X, nonadditive, fuels contain 3 ml tel per gal (from Hirschler et al)

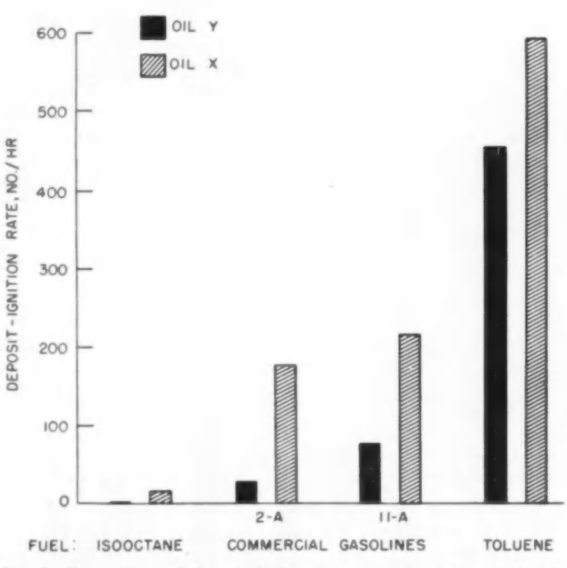


Fig. 8—Comparison of deposit-ignition rates on two oils tested with four fuels. Fuels contain 3 ml tel per gal (from Hirschler et al)

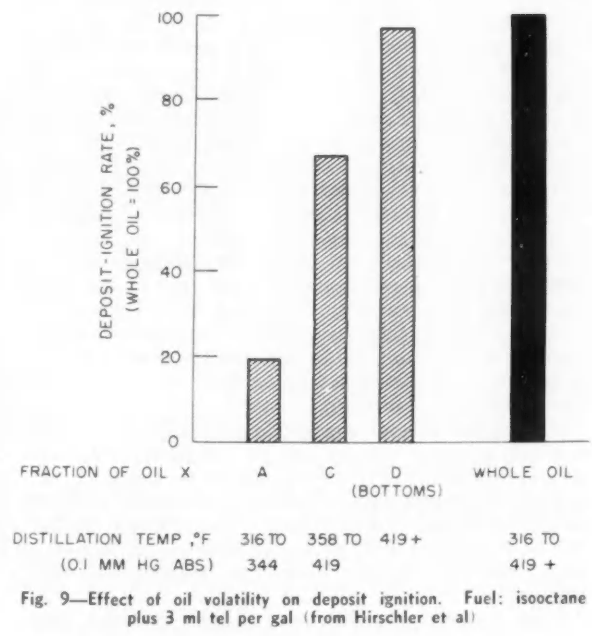


Fig. 9—Effect of oil volatility on deposit ignition. Fuel: isooctane plus 3 ml tel per gal (from Hirschler et al)

Table 2—Analyses of Oils Y and X

	Oil Y	Oil X				
	Whole Oil	Whole Oil	Cut A	Cut B	Cut C	Cut D (Bottoms)
Volume Per Cent of Whole Oil	100	100	25.0	12.5	25.0	35.5
Distillation Range,[a] F	266–356+	316–419+	316–344	344–358	358–419	419+
Gravity, deg API	20.0	29.5	30.4	30.5	29.7	27.9
Viscosity, SUS at 100 F	475.0	307.0	108.5	138.4	204.6	620.4
SUS at 210 F	52.2	53.4	41.1	44.4	48.1	66.4
Sulfur, wt %	0.26	0.28	0.26	0.22	0.24	0.33
Phosphorus, wt %	0.025	0	0	0	0	0
Zinc, wt %	0.014	0	0	0	0	0

[a] At 0.080 to 0.140 mm Hg absolute pressure.

ent refinery processes, were tested. These fuels all contained 3 ml tel per gal and had similar distillation curves with end points of approximately 400 F. The effects of these fuels on deposit ignition are compared in Fig. 5 with those of isooctane and toluene; these latter hydrocarbons produced the minimum and maximum rates found in the group of individual hydrocarbons. It may be observed that all of the gasolines were intermediate between the two hydrocarbons and that appreciable differences in deposit ignition existed among the gasolines. These differences, however, were not directly related to fuel composition as shown by the hydrocarbon-type analyses presented in the upper part of Fig. 5.

It may be concluded that the deposit-ignition tendencies of mixtures of complex hydrocarbons as encountered in full-boiling gasolines cannot be predicted accurately by measurement of their overall hydrocarbon-type proportions by the present standardized techniques. Additional study of mixtures including both simple and complex hydrocarbons would be desirable in order to provide a better understanding of the effects of fuel composition. Nevertheless, the foregoing studies have indicated that fuel volatility and composition are highly important factors in the deposit-ignition problem.

Influence of Operating Conditions on Fuel Performance—It has been found that the differences among leaded fuels can be greatly influenced by engine operating conditions. A series of leaded fuels was tested both under the standard cycling test schedule and under operation at constant speed and load in which the idling portion of the cycle was omitted. This change tended to reduce carbon formation, since it eliminated the periods of rich-mixture idling, acceleration, and deceleration, which are conducive to incomplete combustion. These results are presented in Fig. 6. Although most of the fuels produced less deposit ignition when run under constant-speed, constant-load conditions, as would be expected, the greatest reduction was observed with the aromatic hydrocarbons, benzene and toluene, which are known to produce carbon readily.

From the foregoing, it may be concluded that cycling-type test conditions are advantageous for the study of deposit ignition. This type of test, by providing more opportunity for carbon formation, magnifies differences among fuels, and is believed to be more representative of normal passenger-car operation.

Oil Factors

Lubricating oil, as well as the fuel, contributes to the formation of combustion-chamber deposits. Most of the published information on this effect of oils has been concerned primarily with the weight of deposit formed. More recent work has pointed out that oil characteristics also affect the increase in ordinary knock caused by deposits. It might be expected, then, that deposit ignition would also be influenced by the lubricating oil. In the work discussed below, the effects of different base oils and oil consumption rates were investigated.

Effect of Oil Consumption Rate—Fig. 7 presents the effect of oil consumption rate on deposit ignition with oil X. Data were obtained with two fuels containing 3 ml tel per gal, isooctane and a gasoline blend. Oil consumption rate was varied in these tests by changing piston-ring combinations. These data show that the rate of deposit ignition progressively increased with increasing oil consumption rate, and indicate that the lubricating oil contributes to the problem. Furthermore, the degree to which higher oil consumption rates increase deposit ignition is influenced by the fuel used, since the effect was much less with isooctane than with gasoline blend 2-A. These results also emphasize the importance of maintaining close control of oil consumption in test work.

Effect of Different Base Oils—In order to determine if a difference existed among base oils with regard to deposit ignition, two SAE 20 oils having widely different characteristics were compared. Fig. 8 shows that oil Y consistently produced less deposit ignition than oil X, with each of four different leaded fuels, which were isooctane, toluene, and two commercial gasolines. It appears then

that differences among oils may be observed regardless of the fuel used. These data emphasize the importance of the lubricating oil in this problem and show that when an oil such as oil Y is used in conjunction with a favorable fuel, such as leaded isooctane, deposit ignition can be essentially eliminated.

Among the differences between these two oils are volatility, as shown in Table 2, and hydrocarbon composition. In an effort to study the effect of oil volatility alone, oil X was vacuum distilled into four fractions, and three of these fractions were tested with leaded isooctane for comparison with the whole oil. The results are presented in Fig. 9. Because of variations in oil consumption which were encountered in these tests, the deposit-ignition data are expressed as a percentage of the corresponding value obtained with the whole oil at the different oil consumption rates. Deposit ignition was found to become progressively less as the higher-boiling oil components were removed. This variation in deposit ignition is believed to be due primarily to the changes in oil volatility, since the hydrocarbon-type proportions of the fractions, as measured by ring analysis, were quite uniform throughout the distillation range.

Further confirmation of this volatility effect was observed when a high-boiling fraction amounting to 36% of whole oil X was removed by distillation. Removal of this fraction reduced the rate of deposit ignition to 75% of that obtained with the whole oil. This comparison was made using a commercial gasoline blend (2-A) containing 3 ml tel per gal.

From the foregoing oil studies, it may be concluded that both the characteristics of the lubricating oil and the amount which enters the combustion chamber have a marked influence on deposit ignition. One factor which contributes to the differences among oils is volatility; lower-boiling oils reduce deposit ignition. The importance of other oil characteristics, such as hydrocarbon composition and commercial additives, has yet to be determined.

Effect of Fuels and Lubricants —R. K. Williams and J. R. Landis

ALTHOUGH considerable information is available on the effects of fuel and lubricant composition on the knock problem, little is known concerning the manner in which they influence other types of uncontrolled combustion. The material included in this investigation, obtained by means of road test procedures, deals with the effects of fuel and lubricant composition on types of uncontrolled combustion other than knock. These ignition phenomena are referred to as autoignition for lack of physical data which would permit them to be described more specifically.

Autoignition as it is used here first becomes apparent to the motorist through sounds of sharp, erratic knocking, or a rapid succession of dull thuds, or a combination of these sounds. On recognition of these symptoms it is often possible to turn off the electrical ignition and find that the engine will continue to run. The occurrence of autoignition was verified in this manner for the observations reported here. While it is possible for autoignition to develop sufficiently to cause severe engine damage or a noticeable loss of power, the audible indications are generally detected before these more serious difficulties are encountered.

Fuel Antiknock Quality and Composition

Once engine deposits resulting from operation with a particular combination of fuel and lubricant have developed to the point that autoignition can be detected, the fuel properties by means of which it can be eliminated are of interest. For example, one may wonder whether improvement of fuel antiknock quality by the addition of paraffin or aromatic components would be more effective in eliminating autoignition. This matter is of great importance where autoignition is limiting satisfactory operation of engines in view of the high cost of raising the antiknock quality of fuels from their present levels.

The relative significance of Research and Motor octane number in describing autoignition tendency of fuels was studied by conducting measurements in cars, stabilized with respect to autoignition tendency, using three different types of reference fuels. Identical tests were run in two different overhead-valve, V-8 engines, one at 7.5/1 and one at 8.5/1 compression ratio. Deposits in both cars were accumulated using a commercial, premium-grade gasoline containing tel and an SAE 20W, mixed-base, solvent-refined, distillate oil treated to the MIL-0-2104 detergency level. A 70-mph-limit cross-country schedule was used between measurements of autoignition tendency. Primary reference fuels, severity reference fuels, and a series of full-boiling-range gasolines were used for the measurements. The primary reference fuels were blends of isooctane and normal heptane graduated in 2.5-

octane-number increments. The severity reference fuels were blends of isooctane, normal heptane, and diisobutylene.

The full-boiling-range reference fuels were prepared by blending a high-octane-number commercial-type gasoline, a commercial, premium-grade and a commercial, regular-grade gasoline in such a manner as to provide fuels graduated in steps of approximately two octane numbers. Fuels above 92 Research octane number were obtained by blending the high-octane and premium gasolines, while fuels of lower octane quality were blends of the premium- and regular-grade fuels.

The results of these tests are given for each of the reference fuel series in Table 3. They are expressed in terms of the Research and Motor octane numbers for borderline autoignition. (Borderline autoignition tendency is determined from the octane number at the 50% satisfied point.) The result for each fuel is based on 13 measurements of autoignition tendency.

It can be seen from the tabulation that the maximum spread in Research octane number for borderline autoignition is 2.2 octane numbers. This is evidence that octane number can be used as a measure of autoignition tendency. Since in both engines autoignition tended to occur at low speeds, where the fuel road ratings correspond more closely to their Research than to their Motor ratings, it is not surprising to find that Research octane number provides the better measure of autoignition tendency. In view of the differences shown in Table 3, it appears that there may be a small effect of fuel composition, however.

In order to determine the effects of aromatic content on the autoignition tendency of a fuel, tests were run in which measurements were made in a 1952 overhead-valve V-8 engine at 7.5/1 compression ratio using primary and full-boiling-range reference fuels both with and without benzene additions. In the blends of benzene with primary reference fuels 25% by volume of benzene was used in all members of the series, the balance of the blend consisting of the primary reference fuel required to give the desired Research octane number.

The results of these tests, obtained using a paraffinic-base oil and commercial, premium gasoline during the deposit accumulation, are given in Table 4. Autoignition tendency was measured using a different reference fuel series between each 500 miles of deposit accumulation until seven observations were obtained with each series. The seven

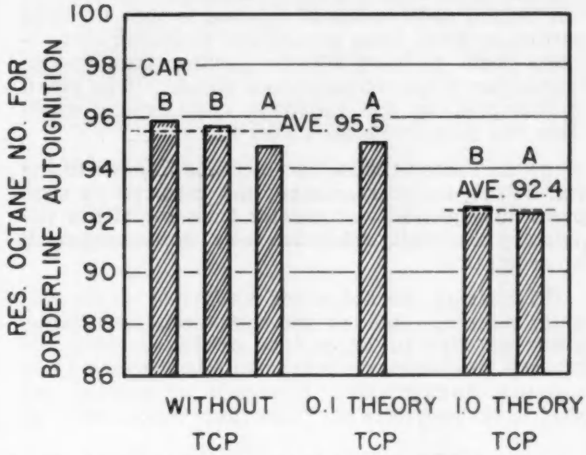


Fig. 10—Effect of tricresyl phosphate on autoignition tendency (from Williams-Landis)

Table 3—Comparison of Different Reference Fuels in Measuring Autoignition Tendency

	Octane Number for Borderline Autoignition			
	7.5/1 Compression Ratio Engine		8.5/1 Compression Ratio Engine	
	Research	Motor	Research	Motor
Primary Reference Fuel	86.0	86.0	93.6	93.6
Severity Reference Fuel	84.6	78.3	94.0	84.1
Full-Boiling-Range Reference Fuel	86.8	79.4	95.0	84.5
Spread	2.2	7.7	1.4	9.5

Table 4—Effect of Fuel Composition on Octane Number for Borderline Autoignition

	Approximate Composition[a], % by volume			Octane Number for Borderline Autoignition	
	Paraffins	Olefins	Aromatics	Research	Motor
Primary Reference Fuel	100	—	—	94.8	94.8
Primary Reference Fuel + Benzene	75	—	25	96.2	92.0
Full-Boiling-Range Reference Fuel	54	30	16	95.5	83.7
Full-Boiling-Range Reference Fuel + Benzene	44	16	40	96.5	85.2
			Spread	1.7	11.1

[a] Silica gel adsorption.

measurements were combined to give one value of borderline autoignition tendency.

A great deal more testing would be required in order to permit general conclusions to be drawn from these data. When considered in light of the information presented in Table 3, however, certain trends are suggested. Considering the wide range in fuel composition involved, the spread in Research octane number of the fuels giving borderline autoignition in any one of these particular engines is not large. Thus, resistance of a fuel to autoignition is determined in part by its antiknock quality.

A second observation of interest is that in these particular tests fuels containing aromatic components seem to have slightly greater autoignition tendencies than aromatic-free blends. This trend is indicated by the following observations made from the data in Tables 3 and 4:

(a) In Table 3 the Research octane number of the full-boiling-range reference fuel required to suppress autoignition was greater than for either the primary or severity reference fuels, which contained no aromatics.

(b) Raising the antiknock quality of either primary reference fuels or the commercial, premium-grade gasoline in Table 4 by adding benzene increased the Research octane number necessary to suppress autoignition. It should be pointed out that in no case were the differences large, however.

Fuel and Lubricant Composition

Lubricating Oil Effects—Three different cars of one 1952 make at 7.5/1 compression ratio were chosen for the tests. In order to add practical significance to the test data, the commercial, premium-grade gasoline was used while deposits were being accumulated according to a 50-mph-limit schedule. Borderline autoignition was measured in terms of full-boiling-range reference fuels using the procedure previously outlined.

Measured in terms of Research octane numbers the borderline autoignition tendency using an asphaltic-base oil free of bright stock (oil B) was almost seven numbers less than that when a paraffinic oil containing bright stock (oil A) was used. The results with a narrow-distillation-cut paraffinic-base oil without bright stock (oil C) were equivalent to those obtained with oil B. This is further evidence that harmful autoignition effects are associated with the physical and chemical characteristics of the high-boiling and not the more volatile components of the lubricating oil.

Effect of Tetraethyl Lead—The base fuel chosen for the tests was a commercial-type gasoline without tel. This fuel was used clear in one car and with the addition of 2.0 ml per gal of tel in the other during the deposit buildup period. The two cars in which observations were made incorporated 9/1 compression ratio, experimental, V-8 engines of identical design. Combustion-chamber deposits were accumulated using the 50-mph-limit deposit schedule. A mixed-base solvent-refined, distillate oil shown by previous experience to provide intermediate effects on knocking and autoignition tendencies was used throughout the tests. In order to avoid contamination of the deposits from the unleaded fuel, observations in both cars were made using the severity reference fuel blends. These fuels did not contain lead.

The car operated on unleaded fuel was *knock-limited* and required a fuel of 92 Research octane number. At the expense of some power loss the fuel antiknock requirement of this car could be reduced by retarding ignition timing. In contrast, the car operated with the leaded fuel was *autoignition-limited* and required a fuel of 95.5 Research octane number for satisfactory operation. In this car retarding ignition timing would produce no reduction in fuel requirement.

In these tests deposits from the leaded as compared with the unleaded fuel materially affected the octane number of the fuel required for acceptable operation. The net effect of the addition of tel to the fuel during deposit buildup was an increase in the fuel antiknock requirement of 3.5 octane numbers. The addition of tel also resulted in a change in the limiting operating factor from knock, which could be eliminated by mechanical adjustment of ignition timing, to autoignition, which could be suppressed only by an increase in fuel antiknock quality.

Effect of Phosphorus Compounds—Recent observations of the beneficial effects of tricresyl phosphate (tcp) as a spark-plug anti-fouling agent in aircraft led to experiments to evaluate the effects of this particular phosphorus compound on autoignition in automotive-type engines. The effects of tcp were measured in a 1952 L-head engine operating at 7.7/1 compression ratio. During deposit accumulation the commercial, premium gasoline and an SAE 20W paraffinic-base oil were used.

Twelve measurements were used to establish autoignition tendency in each test. These tests were conducted in two cars operated with 0, 0.1, and 1.0 theory (Theoretical amount of phosphorus required to convert all of the lead to lead orthophosphate: $Pb_3(PO_4)_2$.) of tcp added to the tank fuel during the deposit buildup period. Results of these tests are given in Fig. 10. From this figure it is evident that 0.1 theory of tcp was ineffective in reducing autoignition tendency but that addition of 1.0 theory, a quantity much larger than normally used, reduced the requirement for borderline autoignition by approximately three octane numbers. Autoignition failures were induced by moderate to heavy knocking in the cars using 1.0 theory tcp, but no knock was noticed prior to the occurrence of autoignition in the tests using untreated fuel. Thus it would appear that retarding ignition timing when 1.0 theory tcp was used would increase the apparent benefit from this additive.

It was found in the majority of instances that the deposits resulting from the use of 1.0 theory of the additive were a fluffy white and were less copious than those from operation with the untreated gasoline.

Occurrence in Present-Day Cars —R. F. Winch

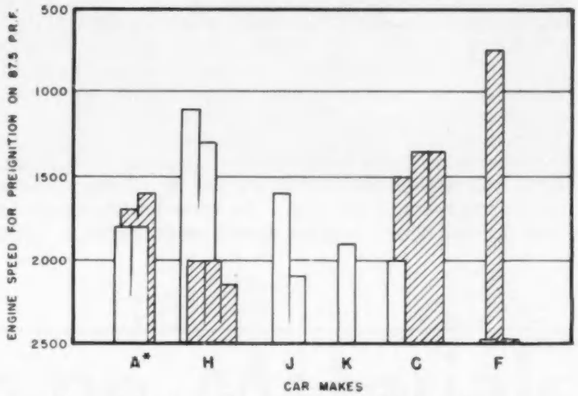
THE occurrence of flame fronts initiated by causes other than the spark discharge have been arbitrarily called preignition. The following definition is included to justify this use of the word. Preignition is the initiation of a flame front by some means other than the spark discharge at some point in the combustion chamber prior to the arrival of the normal flame at that point. Knock does not fit this definition since it does not conform to the conventional flame-front type of combustion.

Wild ping is believed to be a combination of preignition and knock which probably occurs as follows: A preignition cycle is initiated very early in the compression stroke. The rate of pressure and temperature rise due to the advanced flame initiation is so great that spontaneous ignition conditions are reached before very much of the charge is consumed. Because of the critical conditions, the remaining charge is almost instantaneously inflamed, causing a very sudden release of energy. Resulting pressure waves set up the vibrations which produce the characteristic wild ping noise. The similarity between this sudden energy release and the phenomena associated with knock has suggested this part of the wild ping cycle and knock are one and the same thing, differing only in degree or intensity.

Preignition and wild ping were identified by a technique that makes use of the spark plug as an ionization gap. Through oscilloscopic observation of the electrical activity within the ionization gap, it is possible to determine: (1) when an engine is preigniting, and (2) when wild ping occurs. The technique is not dependent on any audible effect. It is capable of indicating preignition occurring both in the presence and absence of knock.

Twenty-one 1952 cars of nine different makes and nine 1953 cars of six different makes have been evaluated to try to get some information on preignition and its relationship to knock. The bulk of this work was done with 1952 cars because of the unavailability of 1953 models at the time this program was started. Also, the 1952 cars were the most modern engines available with an essentially stabilized combustion-chamber deposit condition. In cases where there were significant mechanical changes to the engines in the 1953 models, these cars were also evaluated.

In studying the 30 borrowed cars, ratings were obtained in the "as received" condition. The mileages varied between 200 to 27,000 miles, so that combustion-chamber deposits were not consistent. The



* Transmission limited lowest speed possible for these cars

Fig. 11—Preignition tendency of some 1952 and 1953 cars. Shaded bars are 1952 model data. White bars are 1953 model data (from Winch)

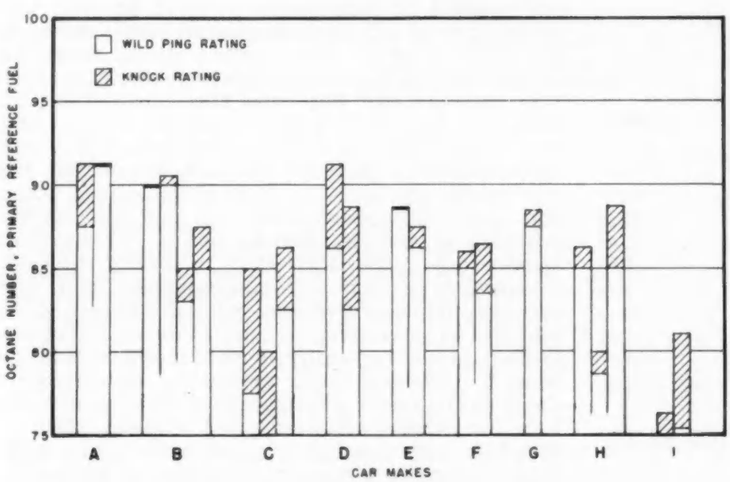


Fig. 12—Knock and wild ping requirements of some 1952 cars (from Winch)

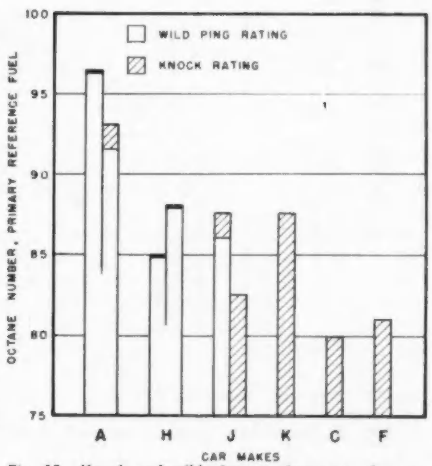


Fig. 13—Knock and wild ping requirements of some 1953 cars (from Winch)

cars had been run on various fuels and lubricants and in widely varying kinds of service.

The data indicate that preignition is indeed a significant and serious problem. It was present in varying degrees in almost all of the 30 cars tested. Fig. 11 shows the speeds at which preignition occurred on 87.5-octane reference fuel for some of the nine 1952 cars tested and all the 1953 cars tested. The scale on the ordinate is engine speed with zero at the top and 2500 rpm at the bottom. The height of the bar then indicates the range of the preignition.

Of the nine different makes of 1952 cars tested, preignition was detected in eight of them. However, there is a considerable spread in the resistance demonstrated by the different makes. Some of them were preigniting almost as soon as the throttle was opened, while the cars of another make showed no preignition difficulty at all on this fuel. In a few cases, there were wide differences in preignition tendency of two cars of the same make. This is not too surprising since none of the cars were in the same combustion-chamber condition; they had not been driven in the same type of service, nor with the same fuels and lubricants.

Because of the transmission characteristics of car A, it was not possible to get a rating of the engine at speeds below 1700 rpm. As soon as the throttle was opened fully, engine speed went right to 1700 rpm. Preignition was present at this speed and was severe enough to indicate it would have been present at much lower speeds. For this reason it is placed as the most severe of the group.

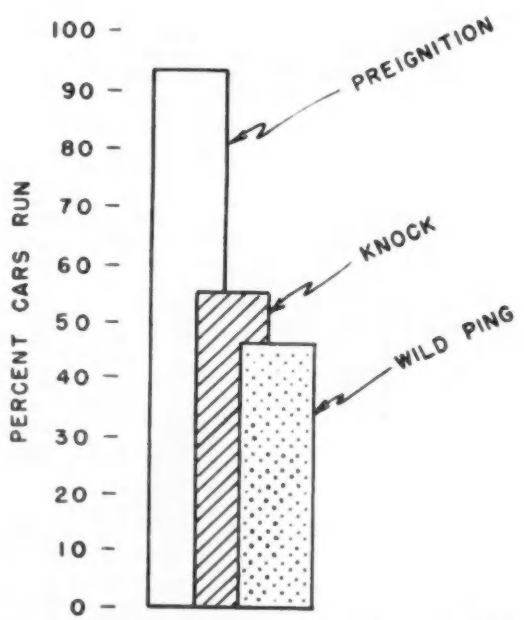


Fig. 14—Commercial, premium fuel performance (from Winch)

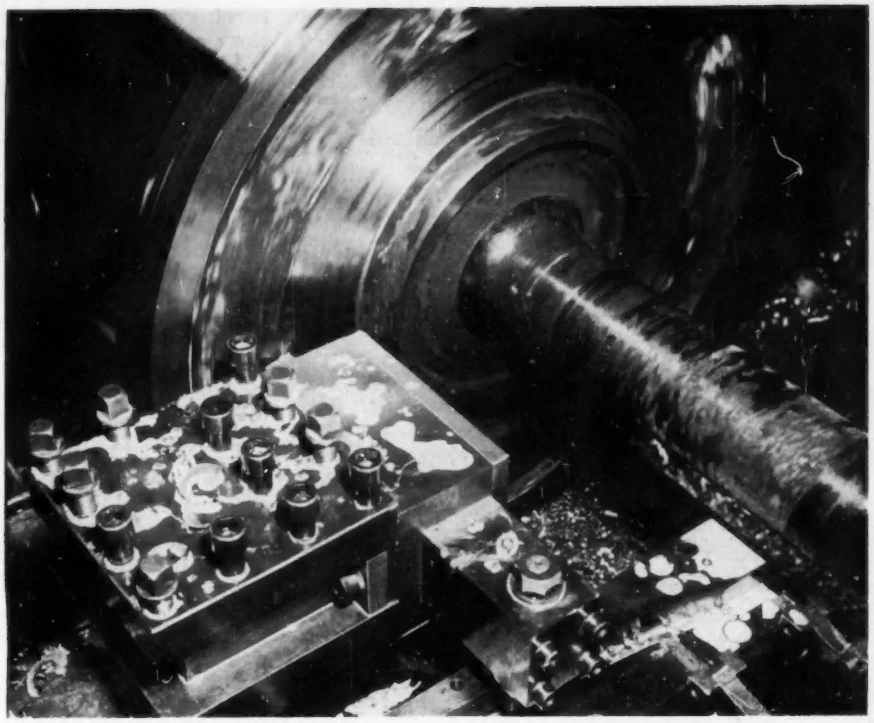
Some of the 1953 cars tested were improved over the 1952 models, while others were noticeably worse. An actual comparison of the level of the 1953 model of car A with the 1952 model cannot be made because of the transmission, but, from observation, it is obviously in more trouble than is the 1952 model. Car H, a mild car in 1952, is apparently joining the ranks of the problem cars.

The knocking and wild ping tendencies of the 1952 cars are shown in Fig. 12. The cross-hatched bars indicate the octane number of the fuel necessary to prevent detonation, while the solid bars represent the octane number of the fuel necessary to prevent wild ping. It was found that cars with the highest preignition tendency in most cases were also highest in octane requirement. Make C is apparently an exception. The octane requirements for these cars are lower than the average for both knock and wild ping. With one car of this make there was no wild ping present at all. With some of the cars of makes A, B, and E, the wild ping requirements are as high as the knock requirements. As previously mentioned, this suggests that preignition in the form of wild ping, and not just detonation, is dictating the octane level of the fuel necessary to satisfy these particular engines.

There was a very large spread in the requirements of the 1953 cars. As shown in Fig. 13, the requirements of car A were exceptionally high and, with one car, were definitely limited by wild ping. Car H was shown to have a higher preignition tendency in 1953 than it did in 1952. The octane requirement is also a lot higher in the new model. Both cars of make H were in considerable wild ping difficulty. The other 1953 cars were relatively mild, makes K, C, and F showing no wild ping tendency at all.

The same 30 cars were also evaluated using a typical commercial, premium-type fuel. The results of this work are summarized in Fig. 14, where the number of cars knocking, wild pinging, and preigniting on a typical commercial fuel is shown as a percentage of the total number rated. Nearly all of the cars had some preignition occurring with this fuel, and over 50% were knocking. Wild ping was occurring with 45% of the cars run on this fuel. For this particular 45%, preignition is a very real problem, a problem that is now reaching the ears of the driver in the form of wild ping. From the results described herein, the old solution for preventing audible knock—octane numbers—is known to be rather ineffective in solving the basic preignition problem. Octane numbers will help suppress the noise of wild ping but are relatively ineffective in controlling the real trouble—preignition. Perhaps there is an easier, more economical, solution than the octane-number approach. If preignition could be eliminated or even reduced, it is conceivable that the present octane-number problem might be relieved or that future engine performance gains might be made without the customary octane requirement penalty.

Metal Cutters Slowly Gaining on Tough Jet Engine Materials



E. J. Weller, General Electric Co.

Report of Panel on Machining held as part of the Aeronautic Production Forum at the SAE National Aeronautic Meeting, New York, April 20, 1953. Panel leader was K. W Stalker, General Electric Co.

MUCH remains to be learned on how to machine new aircraft engine alloys more effectively. But accumulation of experiences from many plants is building up a pool of knowledge that's slowly displacing expensive cut-and-try methods.

Production men are wrestling with machinability in all areas. They're learning more about the relationship between microstructure, hardenability, and machinability. They're developing metal-cutting techniques which make chips faster while extending tool life. And they are finding out which cutting fluids work best with each type metal for each particular type machining operation.

Individually or collectively these men do not yet have all the answers. But many are beginning to emerge.

For example, it is not yet practical to predict the work hardenability of jet engine alloys from composition and properties. However, it's pretty generally true that austenitic materials work-harden more than ferritic magnetic materials. Saying it another way, the more magnetic the material, the less it tends to work-harden.

Here is a typical work-hardening determination:

Samples of vitallium had a hardness of 26 Rockwell C at the start of processing. After cutting, the surface had a hardness of 48 to 52 Rockwell C. A preliminary hardness of 15 Rockwell C was found

The Men Behind These Facts

SERVING on the panel which led the discussion that produced this article were:

- **K. W. Stalker,** chairman
  General Electric Co.
- **E. J. Weller,** secretary
  General Electric Co.
- **W. D. Averill**
  Cincinnati Milling Machine Co.
- **Henry Albert**
  Republic Aviation Corp.
- **R. C. Gibbons**
  Bendix Aviation Corp.
- **R. C. Morris**
  Thompson Products, Inc.
- **Norman Zlatin**
  Metcut Research Associates
- **D. C. Aldrich**
  G. F. Pierce Co.

for 18-8 stainless. Hardness increased to 34 to 35 Rockwell C after machining. These runs were intentionally made with dull tools.

It has been stated and considered that the softer the steel, the better the machining. This is not always the case. Softer materials usually give poorer surface finish. In those cases where surface finish is the major consideration, it may be desirable to make trials on harder materials.

An example of a material that may be too soft is that of copper in the dead soft condition. In this case, chips are particularly sticky; they fill drill flutes, impede chip flow and penetration of the cutting edge. In some steels an isothermal anneal may prove satisfactory.

It is extremely important that materials processed be as uniform as possible. In some cases, a stress relief anneal may be of value in removing hard spots. When possible, materials should be purchased in the annealed condition; preferably to a particular hardness range and microstructure.

Lamallar pearlite is not best for high-speed operations, but is good for drilling, broaching and automatic screw machine operation. Spherodized material often is best for turning operations.

If the customer will tell the vendor what is desired both from a hardness and microstructure standpoint, satisfactory results may be obtained. Again it may be mentioned the best structure for turning is not always the best for finishing operations such as reaming or broaching.

An alternative may be to buy the material in the annealed condition, rough machine the parts, then heat treat to improve the structure as far as finishing operations are concerned. Vendors have available many heat treating cycles. Consultation with the vendor will aid in determining which of these suits his setup and which will provide adequate results for the consumer.

In many cases, the customer does not specify his requirements (as regards structure of the material) completely enough on his purchase order. Usually, if complete information is furnished the vendor, he is in a position to furnish material suitable for the process and parts involved.

Specify Metallurgical Limits

The spread in any material within a given specification may be great. This should be considered. (The manufacturer of material requires tolerances on composition, structure and grain size just as a manufacturer of any part.)

Here is a case in point. On a series of parts being made from a lot of 6-in. steel bars 36 in. long, with a total weight of one ton in the order, a range of microstructures was found. Some of the material was in such a condition that it could be machined at a much higher speed than was originally planned, and some in such a condition that tool life was seriously affected. With no previous indication as to the variation which might be expected, the machine shop was unable to capitalize on material of improved machinability and while losing money on those parts made from the material which was more difficult to machine.

Considerable progress has been made in specific machining operations. Milling of stainless steel is one of these. Those who have met with success here will tell you that correct operator instructions, use of carbide cutters, and proper cutting fluid selection are important.

Insert type cutters with carbide tips are used to the greatest extent and are giving the best results. The grades of carbide in more common use are the straight tungsten carbide composition such as Kennametal K-6 and Carboloy 44A.

Some are using minus 6-deg axial rake and minus 6-deg radial rake. Others, 0-deg axial combined with 6-deg radial rake.

It has been found that considerable chipping may occur with high positive rake, and wear is the major problem with high negative rake. Chips welding to the cutting edges have proved to be a major problem. If these chips are knocked off in cutting, the carbide tips tend to chip.

Chip welding is not so bad in climb cutting as in conventional cutting, for as the cutter leaves the work in climb cutting, the chip thickness approaches zero.

If chip loads in the neighborhood of 0.001 to 0.002 in. are used, there may be some tendency for excessive wear to occur. That's because a major portion of the cutting is being done in a work hardened area.

Interrupted cuts on lathes, boring mills, and similar pieces of equipment often have given difficulty when carbide tools are being used, since here chip-

ping occurs. In these cases, cast alloy tools operating in the neighborhood of 140 fpm with a feed of 0.008 in. have proven satisfactory when using water type cutting fluids. In general, feeds of 0.005 to 0.008 in. are being used for turning operations.

Titanium Emphasis on Design Needs

Titanium is right up in front on the problem metals list, with its machining toughness. And it doesn't look as if producers of titanium alloys will be able to make much improvement in machinability. That's because the material is manufactured to meet engineering design requirements, with machinability secondary.

One of the producers of sponge has improved his product, but those involved in further working have contaminated the material particularly with oxygen and nitrogen. It may be necessary to develop or change melting techniques to avoid this contamination.

On a few samples having 0.7% carbon and machined in the forged and annealed condition, machinability was slightly improved by annealing. Operations were conducted at 75 fpm in the forged condition. This was increased to 100 fpm after annealing. In an alloy containing 0.4% carbon annealing improved machinability 5 to 10%.

In general, it can be said that annealing does not appreciably change the machinability of these alloys.

Some tests to date indicate carbon content has a considerable effect on the machinability of titanium alloys. In one group of tests carbon content varied from 0.01% to 0.07%. In this range it was found necessary to decrease the cutting speed by ½. The following tabulation indicates the approximate results of some tests performed to date.

Ti 150A	(C 0.01%)	200 fpm
MST	(3% alum., 5% chr., 0.07% C)	75–100 fpm
RC 130B	(Remcru)	150 fpm

In a series of tests on titanium alloys having a carbon range from less than 0.1% to 0.7%, it was found that those materials with less than 0.3% tapped better. For example, in an alloy with 0.40% carbon the tapping speed was 15 to 20 fpm. When tapping 0.01% carbon material, tapping speed was tripled.

Getting Around Warpage

Not only are jet engine metals tough to machine, but the sections are thin. So warpage is another bugaboo in metal-cutting shops these days.

Sometimes it has proven advantageous to add material on the side opposite the thin section to eliminate warpage. This has helped, but will not necessarily correct the difficulty.

It is extremely important to rigidly back up parts being machined. Most new jobs require their own particular analysis since each has its particular problems. Again, rigid fixtures are essential.

In the milling air frames of 75 ST aluminum, the warpage involved gives considerable difficulty. Nevertheless, it has been found that if parts are cast, stress relief annealed, rough machined, annealed, finish machined and then given a final anneal to make sure that no stress remains, distortion of finished parts may be minimized. Tolerances on cast parts have been held to 0.0005 and even in some cases to 0.0001. The three anneals have proven essential to obtain these tolerances on cast parts.

Belts were applied to finishing thin aluminum sections to find if warpage of the material is due to the removal of skin or to the heat produced from milling. Sheet ground from 0.375 in. down to 0.04 in. in thickness over a 4¼-ft length on a sheet 4 ft wide by 10 ft long bowed only ⅛ in. This condition indicated only bowing, the section remained uniform in thickness. Approximately 30 gpm of cutting fluid was used.

The sheets were held down on a vacuum chuck made from ordinary steel floor plate to which rubber tubing was attached. A vacuum of 27 in. Hg was used. Sheets of the above sizes were held taking a depth of cut of 0.100 in.

To prevent warpage of aluminum parts, it is necessary to rough machine, stress relief anneal and then finish machine. The best operation was achieved when aluminum in the SO condition was used. The material is rough annealed, allowed to lay two to three days, then finish machined. Even so, fixtures which closely support the parts must be used.

Which Cutting Fluid?

Integrally tied in with the development of an acceptable machining procedure is the proper selection and application of the cutting fluid. What oil to use and how to use it stand high on the list of queries in machining today.

If you ask how to determine the correct fluid for a particular job, the experts will tell you to evaluate the job carefully. That's because the difficulty in many cases is not due to the cutting fluid, but to other details.

It has been found worthwhile to set up a laboratory to test and analyze cutting fluids. Coordination between this laboratory and the factory is extremely important. A man or group should be set up to coordinate the project and evaluate results. This same group or individual should be assigned the application and trouble shooting involved in the factory.

One company had over 200 varieties of oil in their oil house. A change of system was made whereby the number of people involved in purchasing and evaluating cutting fluids was limited—first to the purchasing department and second to those desiring to submit cutting fluids. The vendors approved by purchasing are forwarded to the manufacturing department.

If manufacturing and purchasing agree that a vendors material should be tried, material is purchased and assigned a trial order number. Preliminary laboratory tests are then made. If these prove satisfactory, the material is assigned to a particular machine in the factory. Planning, methods, and laboratory personnel observe the operation closely. When satisfactory materials are found they are given a standard specification number.

All other oils have been removed from the factory. All machine tools are tagged indicating the type cutting fluid that machine should use. In the case of a trial the machine is also labeled. When

a vendor is interested in bringing in his product, he must also bring in a service engineer from his plant to explain the value of any new material. The safety and health department checks the fluid for ingredients.

Service personnel operating in the factory are usually developed from shop people who are given a training in cutting fluids.

All machining tests with a cutting fluid are done on a production set up. The particular company involved mentioned the fact that considerable troubles due to interrupted production were involved in testing cutting fluids under production conditions. It might be mentioned that this particular company has six individuals assigned to factory service work on cutting fluids.

Many new cutting fluids have been developed to meet changing requirements. Some of these are good, some not. It has been found that heavier cutting fluids may occasionally vapor lock more than water soluble fluids.

Controlling the mixing of soluble oils is important if results indicated in tests (like those mentioned above) are to be achieved. Assigning an oiler to the mixing of these materials has been tried. The results obtained were not too successful. It was found more satisfactory to mix the oil in a central location such as an oil house. The mixed material is then forwarded to the factory for use.

Control is maintained over the mixture in a machine by use of a Babcox test cell to check the specific gravity of the solution in each machine. This test is rapid, yields satisfactory results and also seems to have a good psychological effect. In such a set up, it has often been the case that operators will remind their supervision that a check is due.

On machines used for high production or production operation, a check system is set up to assure that water and base material are properly added. These additions make up for drag out and evaporation. When such a system is properly in operation and basic data has been obtained on a part, machine operation becomes uniform. Engineering service is maintained by responsible individuals.

When it is desired to change from one type cutting fluid to another, it is necessary to clear with the laboratory.

Cool Coolant

In the past few years there has been considerable experimentation with CO_2 as a cutting fluid. To date the material is far from a cure-all for machining woes.

In most applications CO_2 hasn't come up to expectations. Sufficient quantities of the material were not available. Another stumbling block is its cost. Right now it looks prohibitive. CO_2 may have possibilities in grinding if only the heat involved is considered.

Although it tends to keep work cooler, CO_2 has shown little effect on the level of work hardening in jet engine materials. Work hardening is affected mostly by tool cutting angle. However, CO_2 may show to advantage in machining titanium, which develops considerable heat when being machined.

The big trouble with CO_2 is that it lacks lubricity. Some attempt has been made to combine CO_2 with a liquid lubricant. But the problem is to find a liquid that does not freeze at the temperatures involved. Kerosene is such a material. However, it tends to pick up water, and then becomes too slushy. A satisfactory material has not yet been found.

Somewhat more successful experiments have been made with another type of cutting lube—waxes. At present wax pellets are being inserted into drilled holes before tapping. The results have been satisfactory. There has been some objection to the time involved in inserting the pellet.

Coating the tap with wax rather than filling the hole also has proved satisfactory.

In many cases the wax was left on the part and provided a protective coating. When the wax has to be removed, cleaning in a degreaser turns the trick.

Lengthening Tool Life

Still another phase of machining studies today is the determination of tool life. Radioisotopes have given this work a big lift. That's because radioactive tools used in tool-life testing have made it possible to accelerate the data-gathering process without requiring the running of tools at abnormally high speeds. Therefore, more predictable, uniform, and dependable results are obtained.

Another method is the use of a hardness indentation on the flank of the tool as a base from which to measure tool wear. This method consists of grinding a wear land approximately 0.005 in. wide and making a Knoop impression thereon. The dimensions of the impression are measured prior to testing.

After the tool has been running a specified distance or for a definite length of time, the dimensions of the impression are again measured. Minute amounts of wear result in a considerable change in the dimensions of the Knoop impression. This method has given very close results.

The standard means of measuring cutting forces have also been applied to the evaluation of cutting fluids. In principle, this method indicates changes in coefficient of friction. Those materials which result in the lowest friction coefficient usually improve tool life most.

Cutting fluids which are active (such as the sulfur base and sulpho-chlorinated oils) show to best advantage at lower cutting speeds, that is, below 150 fpm. It is in this speed range that such materials have given satisfactory results. Sulfur and/or chlorine do not seem to have time to act effectively at speeds greater than 150 fpm due to the fact that the time required for the formation of protective films is not available. Therefore, water soluble or emulsion type cutting fluids are used at the higher speeds to yield more suitable results. In this case cooling is the major factor desired. This is accomplished best with soluble oils since water is a much more effective heat absorbing medium than oil.

(The report on which this article is based is available in full in multilithographed form together with reports of the nine other panel sessions of the 1953 SAE Aeronautic Production Forum. This publication, SP-301, is available from the SAE Special Publications Department. Price: $2.00 to members, $4.00 to nonmembers.)

Building Stability into the Modern Car

O. D. Dillman and E. J. Collier, Chrysler Corp.

Excerpts from paper, "Building Stability into the Modern Automobile," presented at a meeting of the SAE Atlanta Group, Atlanta, Ga., Jan. 19, 1953.

MODERN demands for comfort and safety are largely responsible for the increased emphasis being placed on passenger-car stability. If this stability is to be attained under all driving conditions, many factors must be considered in the design of the car, such as:

- Oversteering and understeering.
- Tire slip angle.
- Front suspension.
- Rear suspension.
- Steering linkage.
- Power steering.
- Weight distribution.

Oversteering and Understeering

The condition that demands the most exacting requirements of a modern suspension is simply that of negotiating a sharp curve at high speed.

One of two conditions exists as a driver endeavors to keep his car on the road and follow the road dividing strip. The car will tend either to oversteer or to understeer, depending upon the optimum design conditions that have been built into it; this, because the car in itself has the features to produce one of these two conditions, aside from the amount of turn that the driver applies to the steering wheel.

Fig. 1 illustrates how these features feel to the driver as he compensates for the behavior of his 4-wheeled vehicle. Shown in the shaded area is a deviation path that would have to be compensated for to overcome the oversteering or understeering caused by the components of the car suspension.

Slip Angle

As tires have been built to operate at lower pressures, the tire area in contact with the ground has increased. This section is known as the "patch area," and here lies the secret of tire aligning torque. (See Fig. 2.)

If this low-pressure tire is applied to the car going around the curve in Fig. 1, a condition similar

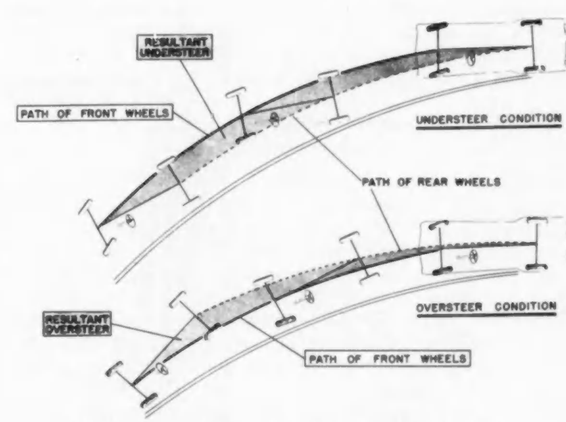


Fig. 1—Car understeering and oversteering in turns

to that illustrated on the right exists. The suspension engineer says that the tire tends to slip. While this does not really mean that the tire scrubs across the ground, it does deflect away from the center position on the wheel rim. This deflection is produced as the result of a centrifugal force exerted on the axles by the mass of the vehicle.

If a given point is traced as it travels around the surface of the tire, a strange thing is found to happen to the line of motion, in that the car is no longer going in the direction that the front wheels are pointing. The change in direction of travel is called the "slip angle" of the tire. This slip angle is a function of the patch area and tire deflection caused by car speed and load.

The slip angle of the front wheels will tend to produce understeering in the car going around the bend. By the same token, a car heavily loaded in the rear end will create more slip angle in the rear tires than in the front ones, and the car tends to oversteer.

Roll Center of the Front Suspension

The three major links that produce the geometry of a front suspension are the upper and lower control arms connected at their outer ends by the steering knuckle support.

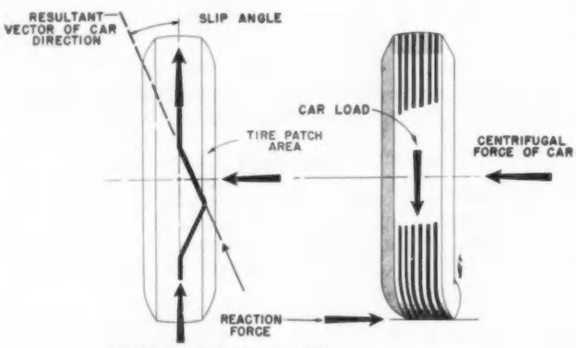


Fig. 2—Slip angle of tire

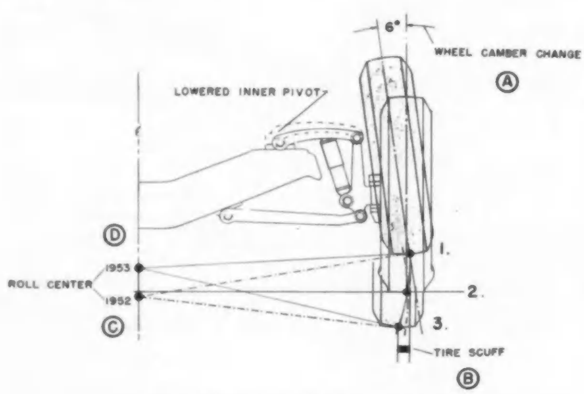


Fig. 3—Roll center of front suspension

By correctly designing the placement of the three major components in this linkage, the tire and wheel can be made to travel from jounce to rebound following any desired path. There are two distinctly different wheel gyrations to which the engineer lately has been giving considerable importance. As shown in Fig. 3, point (A) is the camber change of the centerline of the tire as the wheel travels up and down, and point (B) is called the tire scuff.

As the suspension goes from jounce to rebound, a projected point of the tire contacting the road will travel horizontally along this heavy black line. Unlike tire slip, this point does scrape across the road, or would if the tire were not rotating. The two important points about scuff are the damping action it applies to a jouncing car and its effect on determining the roll center of the suspension.

If we draw an arc through points 1, 2, and 3, the point at which the radius of this arc intersects the vertical centerline of the front crossmember, when the suspension is in the normal position, locates the height of the roll center. Since this point of rotation only indicates the behavior of the front of the car, we must look further to determine what effect this roll center has on the entire car.

Roll Axis

Fig. 4 locates the roll center of the rear suspension at a point below the differential carrier centerline. In this case, the method of attaching the rear axle to the frame is the governing factor of roll center. This is, of course, the springs which are attached to the axle housing spring seats.

Because the car body and frame are supported by the front and rear suspensions, the roll centers of each determine the roll axis of the entire car. That is the line connecting point A to point B in Fig. 4.

Centrifugal force applied to the car body as the car goes around a curve will react at the center of the car mass or at the center of gravity. Depending on the length of the dark line, running from the c.g. to the intersection of the roll axis, the car will have a large or a small overturning couple. Thus, by raising the position of the front roll center, the overturning couple can be decreased and the amount of car body roll reduced.

By designing a negative camber in jounce and slight positive camber in rebound, the following

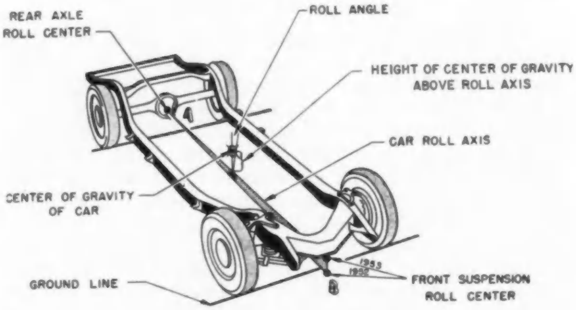


Fig. 4—Car overturning couple

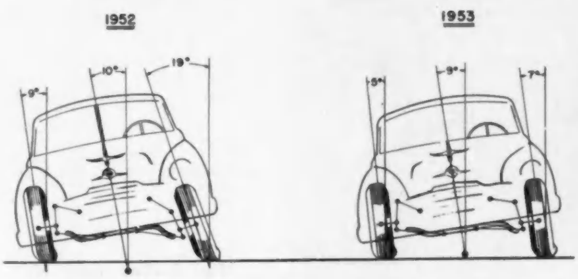


Fig. 5—Wheel camber on curves and sway bar action

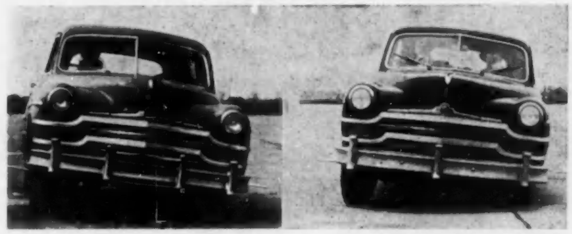


Fig. 6—Roll center effect on car. Left: low roll center car; right: high roll center car

condition is produced when our car starts to roll into a turn. Fig. 5 illustrates the front view of two cars taking a curve at high speed. The car at the right has camber characteristics similar to those just mentioned. When the right wheel (left in picture) starts into a jounce it takes on negative camber. At the same time, the left wheel starts into a rebound and produces some positive camber. The result is a very desirable "biting" of the wheels into the curve, thus improving stability.

Shown in the left-hand picture is a conventional type of front suspension, which allows both wheels to take on a negative camber. Possible disadvantages of this tire heeling are excessive tire squealing, increased car roll, and again the ever-present tire slip angle contributing to understeering.

Sway Bar

Fig. 5 also shows the sway eliminator, which connects the two front suspension lower control arms to the car frame. This antirolling device comes into play only when there is a differential motion between the left and right lower control arms. In substance, this sway controller is nothing more than a bar of spring steel ¾ in. in diameter. It is held at either end by a rubber bushing and supported at two points on the frame by additional rubber mountings. As each side of the suspension goes into the jounce or rebound, one at the same rate as the other, the sway bar merely goes along for the ride, with no work being done. Now, if the car starts to roll, as shown in the left-hand picture, the right wheel starts into jounce and the left wheel approaches the rebound condition. A differential action between the two lower control arms is set up and the sway bar is twisted, as shown. You almost get something for nothing in this maneuver, in that the car is literally lifting itself by its boot straps. Unfortunately, the two sides of the front suspension do not always act as a ballet team on mildly rough road travel and the result is continued differential action. This ride condition governs the diameter to which the sway bar must be held in order not to create a harshness under high-speed highway traveling.

Two test cars (Fig. 6) were used to substantiate much of the material covered. These cars were run under identical testing conditions, with only a change in suspension geometry.

The car at the left has a roll center 1.52 in. below the ground; the wheel camber change is 9½ deg on the right and 9 deg on the left wheel. The resulting car body roll angle is 7 deg. The experimental suspension on the right-hand car has a roll center 3.89 in. above the ground, camber angles of 5½ and 6¾ deg, and an all-important body roll reduction of 21%

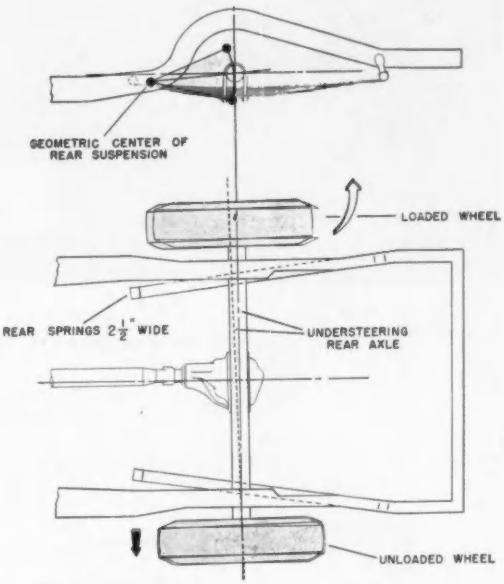


Fig. 7—Steering geometry of rear suspension

Rear Suspension

Fig. 7 indicates the make-up of the geometry used in a Hotchkiss rear suspension. The upper view illustrates the geometric center of the entire left side of a rear suspension. This true center is not at the anchor point of the front spring eye, but slightly to the rear and up from this point. To determine what the center of the rear axle, and thus the center of the rear wheels, will do under spring action, notice the shaded area of this arc. As the wheels go from jounce to rebound, a short, quick arc is described by the center of the wheel. The point of major interest is that the wheel center is moving closer to the front of the car in both of

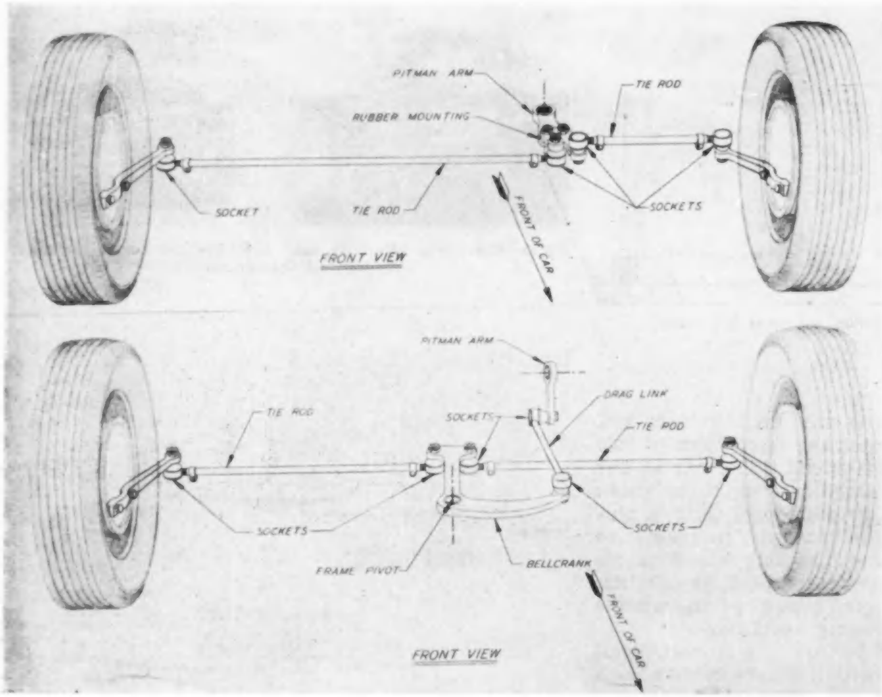
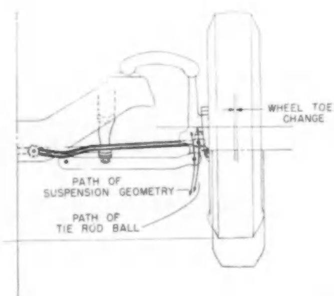


Fig. 8—Two types of steering linkage. Upper view shows long-short arm linkage. Lower view shows center arm steering linkage with bell crank intermediate arm



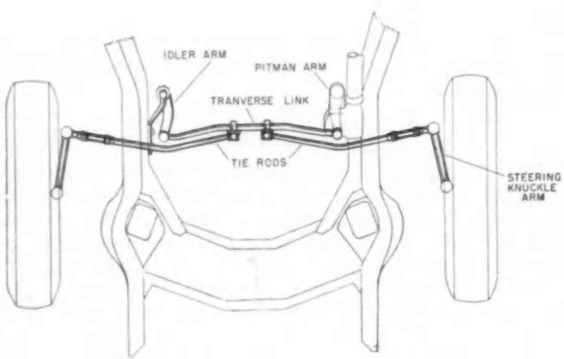


Fig. 9—Symmetrical idler arm steering

these extreme conditions. In effect, the wheelbase of the car is reduced. In the top or plan view of the same rear suspension, we have simulated the position of the rear wheels as the car in Fig. 1 travels around the bend. The roll of the car being toward the outside, the right wheel is forced into an upward position while the left rear wheel is starting downward, away from the car frame. The result is two projected points from the top view that cause the centerline of the rear wheels to askew diagonally across the car body. In this case the car is helped to understeer.

The use of splayed rear springs in this car has allowed two important improvements in chassis design; first, the use of lower deep frame side rails, and an ideal location of the front spring eye, to compensate for incorrect rear end steering. A change in the front spring eye will either induce oversteering or understeering in the rear axle.

The extra wide 2½-in. rear springs have only five leaves as compared to the conventional type, which has nine or more. The main reason for this spring is to reduce the number of contacting surfaces and thus reduce static friction, which hinders a smooth ride. This spring has special, wax-impregnated cloth interliners, which help to reduce friction. In addition to reduced friction, the 2½-in. width allows a wider spring shackle and front eye bushing, which increases car stability. Recent testing of the 1952 1¾-in. wide spring versus the 1953 2½-in. rear spring showed a reduction in car body roll of about 10%.

Steering

The most prominent steering linkages used on American passenger cars are: the long and short

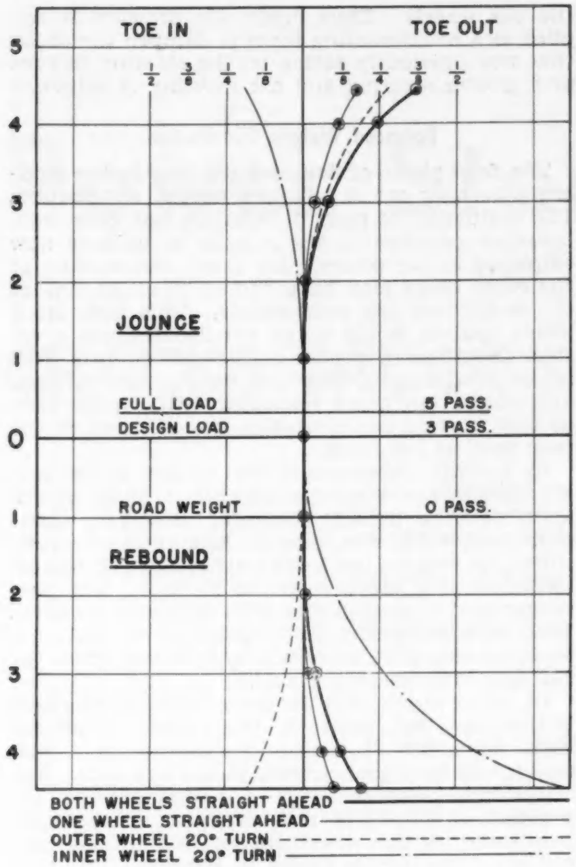


Fig. 10—Front wheel toe change

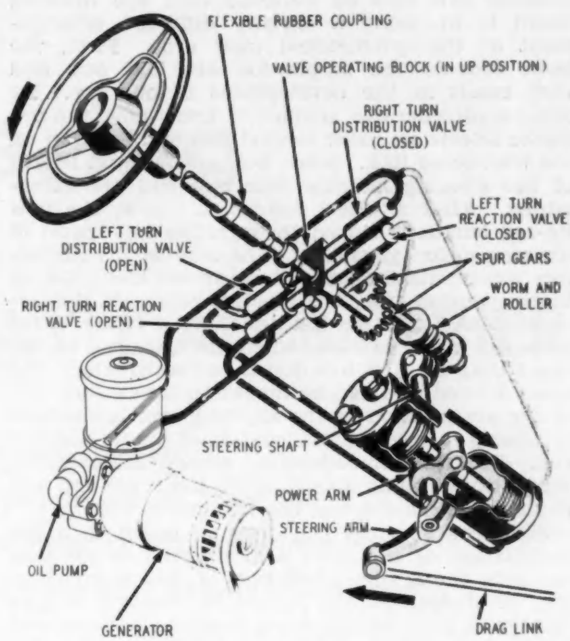


Fig. 11—Operation of power steering during left turn

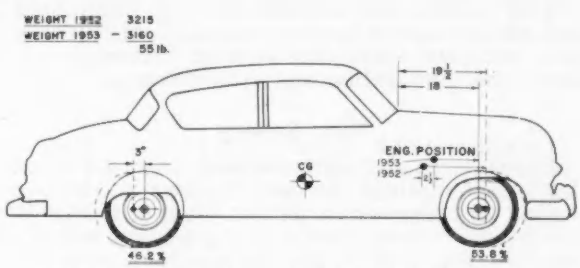


Fig. 12—Weight distribution for 1952 and 1953 Plymouths

tie-rod type, the center arm type, and the transverse link or symmetrical idler arm.

The long and short tie-rod type (Fig. 8) is the most elementary in design, consisting of one short tie-rod connecting the steering gear pitman arm to the left steering knuckle arm, and a long tie-rod joining the pitman arm to the right steering arm.

The center arm type (Fig. 8) employs a fore-and-aft drag link that actuates a center arm, usually located in the center of the front crossmember. This arm controls the tie-rods. Again two rods are used but this time they are of equal length. This linkage produces a symmetrical design of steering geometry.

The most popular type of steering linkage in use today is the transverse link or symmetrical idler arm. Fig. 9 indicates the major components of the 1953 Dodge Red Ram steering. Notice that the pitman arm and idler arm carry the transverse link in a parallelogram action. The two tie-rods are of equal length and connect the transverse link to the steering knuckle arms.

These three types of steering are only a few of the many modifications that have grown to make up the correct steering linkage to fit the design requirements of a chassis. To be sure, the economics of a design is often as important as the space requirements dictated by the chassis layout.

In the upper view of Fig. 9, you are looking into the front of a chassis equipped with idler arm steering. For the sake of clarity the arc that the suspension describes, as it goes into rebound, has been slightly displaced from the arc of the left tie-rod end. These arcs are not equal and would cross each other if they were continued far enough. But since the full wheel travel downward is only 4½ in., the remaining segment is not of interest. The mismatch in the two arcs will result in the car wheel being turned by the suspension alone, as it travels. This differential motion will rotate the wheel (shown in cross-hatching) outward and cause a toe-out condition.

How then does the designer compensate for any

adverse wheel toe changes? One way in which this problem can first be attacked over the drawing board is by using a slightly different arrangement of the symmetrical idler arm. First, the basic arcs of the suspension are laid out, and they result in the development of one arc. By using a considerable amount of know-how, the designer selects an inner tie-rod ball end location on the transverse link. Next, the position and length of the steering knuckle arm ball end are determined. After a wheel Ackerman check, the new tie-rod length is traced through the full travel of the suspension geometry. The results, if satisfactory, are points similar to those shown along side of the suspension arc. These points represent the tie-rod end and must be multiplied by a factor, 8 for instance, to indicate the wheel toe change. In the event that the first location is not satisfactory, the inner tie-rod end can be moved to a new location, or the arc position of the steering arm is changed by raising or lowering the location of the tie-rod ball end. This last consideration should indicate the versatility of being able to move the inner rod end to the ideal point along the transverse link.

Now let's go from the drawing board to a car installation of this idler arm steering to see how accurate the design prediction of this layout was. Fig. 10 shows the full jounce to rebound of this linkage in a car in the straight-ahead position and for 20-deg wheel turns to the right and left. The point of interest is that, at any normal driving condition, our differential action is nil and this car should have little or no wheel fight in addition to even tire wear.

This section was included because wheel fight contributes heavily to driver reaction. Also, jounce and rebound suspension-steering influence car front end oversteering and understeering.

Power Steering

Power steering virtually eliminates all road shock from reaching the driver and stabilizes car steering during all operating conditions. Shown in Fig. 11 are the functioning parts of Chrysler power steering. As the driver turns the steering wheel, the steering column spur gear climbs up or down with respect to the worm shaft axis. This causes an up or down motion of the valve operating block. While the movement of the block is of very small magnitude, it is sufficient to open and close the distribution and reaction valves in the desired combination. This produces a difference in pressure between the power cylinders so that the pistons move the power arm in the same direction as the worm-and-roller is driving the steering gear shaft.

In regard to the problem of car stability, how does the power steering unit work as the front wheels of a car drop into a chuck hole or encounter other road obstacles? In a reverse action, the steering linkage is started in motion by a turning of the car wheel. As the driver is holding the steering wheel, the spur gear mounted at the end of the steering gear shaft tries to climb upon the gear at the end of the steering column. As a result, the valve operating block moves up or down and the valves are set in operation, causing the oil pressure in the power cylinders to oppose the movement of the car wheels. Thus, hydraulic pressure is applied as a counteracting force to dampen the shock that was previously acting on the steering linkage and greater steering and car stability is achieved.

Balanced Weight Distribution

The final phase of designed stability in the modern passenger car is balanced weight distribution. The evaluation of mass distribution has gone from horseless carriage to the science of balance now employed in our present-day cars. Automobiles of the early 1900's may have had as much as 70% of the weight on the rear wheels. This 30% front wheel loading would make our modern car oversteer dangerously when going around curves. This is one fundamental objection on the part of some automotive engineers regarding rear-engine cars, as this type of car is usually loaded more at the rear than at the front.

By careful placement of the modern passenger-car chassis and body components, a 50-50 weight distribution is usually obtained. However, whenever possible, the balance of loading is generally shifted to 55% on the front wheels, since an understeering car is much easier to manage. The passenger load is applied primarily to the rear wheels. With a curb weight distribution of 45-55%, the 50-50 loading is more nearly approached when the car has a full passenger load.

Of equal importance to the suspension engineer is the mass distribution in the vehicle. The four most important suspension frequencies of a passenger car are: jounce, roll, pitch, and yaw. The latter two—pitch and yaw—are dependent on the moment of inertia of the vehicle at an axis perpendicular to the wheelbase passing through the center of the car, as shown in Fig. 12.

The mass of the car could be split in two sections and placed several feet off the front and rear bumpers and, if properly split, the basic 47-53% wheel weight distribution would remain the same. But the moment of inertia would be changed considerably over this car shown. The car weight has only been decreased 55 lbs from 1952 to 1953 in the Plymouth. However, the wheelbase has been shortened 4½ in. and the distance between the centerline of the front wheels and the engine—a big factor in mass distribution—has been decreased 2½ in.

Briefly, balanced weight distribution means this. The jounce rate of the front and rear suspension has remained unchanged. This tends to retain car spring stability. The pitch and yaw car frequencies depend on the moment of inertia, as well as being a function of the square of the distance from the center of gravity to the centers of the front and rear springs. While the moment of inertia of some of our 1953 cars has been relatively unchanged, the wheelbase has been shortened, thus reducing the distance from the c.g. to the centers of the front and rear springs. As a result, the pitch and yaw frequencies have been reduced in these cars. To the engineer this means a better "isolation ratio"; to the driver it means a wider range of driving conditions with less road disturbance.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Power Steering

CRACKS TRUCK-PAYLOAD BARRIER

. . . Thanks to power steering, more load can be put on a truck front axle. It gives drivers the muscles that have long been needed to steer vehicles with heavily loaded front ends.

S. G. Johnson, International Harvester Co.

Excerpts from paper "Greater Payload with Power Steering" presented at SAE National Transportation Meeting, Chicago, Nov. 3, 1953.

THANKS to power steering, truck chassis design can be modified to permit a substantial increase in payload in most states. With it, front axles can be made to carry a greater share of the load. No longer does steering effort need to be the limiting factor for front-axle loads.

The problem now becomes one of how to appreciably increase the front-axle load. Three questions immediately arise:

- What is the maximum feasible front-axle load?
- What type of vehicle or combination of vehicles is most likely to use maximum front-axle loads?
- Would increased front-axle loads violate state regulations governing gross combination weights?

The answer to the first question would seem to be that power steering could allow front-axle loads up to the limit prescribed by law (18,000 lb in most states). However, such an increase would require dual front tires since most states limit the amount of weight that can be carried per inch of tire width. Also, from a safety point of view, the front-axle load should not exceed the amount that could be controlled mechanically, should the power system fail.

In view of these things, it appears best to base the maximum front-axle load on tire capacity with single front and dual rear tires, which would give a 1/3-2/3 weight distribution. Since most states limit axles to 18,000 lb, this would make 9000 lb the maximum practicable front-axle load.

3500 lb Bonus with Power Steering

As for question two, a study of available data indicates that the conventional two-axle truck-tractor, with both single and tandem-axle semitrailers, fills the bill. It not only accumulates the vast majority of the nation's highway ton-miles, but also is considerably lighter on the front axle than the prescribed limit based on tire capacity. Actually, the study showed that front-axle loads on these combinations do not exceed 5500 lb and generally are somewhat lower.

Having established that the front axle should carry up to 9000 lb, it is easy to see that increasing the load by 3500 lb will require a radical change in chassis weight distribution. It goes without saying, however, that this change must be accomplished with minimum effect on weight, cost, and accessibility of major chassis units.

A thorough investigation indicates that the desired distribution cannot be obtained without a certain amount of chassis weight overhanging the front axle. (In addition to increasing front-axle

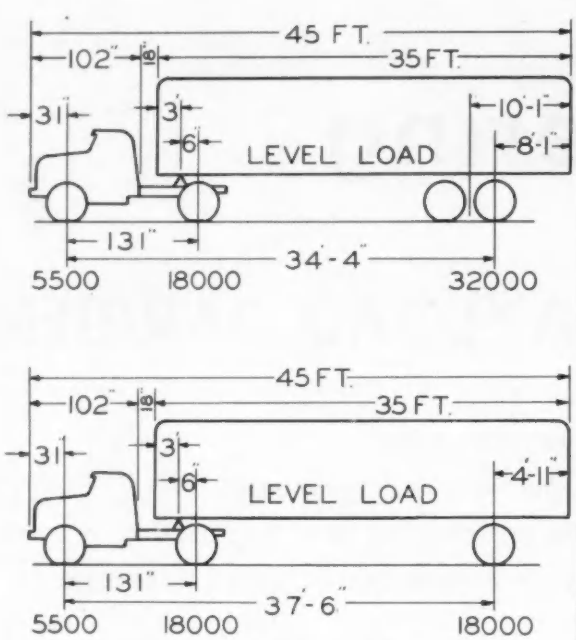


Fig. 1—Typical dimensions and load figures for conventional truck-tractors with 35-ft semitrailers, both single and tandem axle

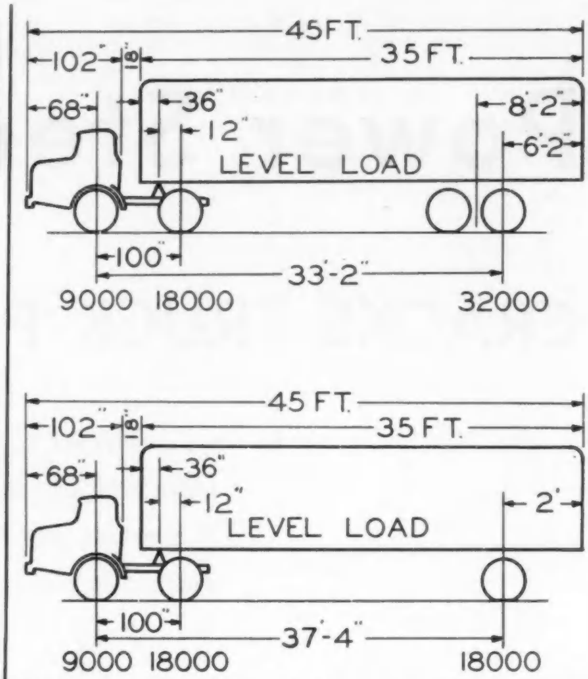


Fig. 2—Typical dimensions and load figures for vehicle combinations in which the front axle of each tractor has been moved rearward and the fifth wheel moved forward to give a front-axle load of 9000 lb

load, this decreases chassis weight on the rear axle, thus permitting more payload.)

There are several ways to accomplish this. The COE (cab-over-engine) with properly positioned axle is one. Another approach is to move the front axle on a conventional chassis rearward (but not so far back there isn't enough weight on the rear wheels for traction when the trailer is empty).

A further increase in payload will be made possible by shortening the truck-tractor wheelbase. For example, with a conventional 140-in.-wheelbase tractor, each inch the fifth wheel is moved forward increases the front-axle load about 100 lb; with a 100-in. wheelbase and the same fifth-wheel load, each inch forward increases the front-axle load 140 lb.

Thus it can be seen that the necessary change in load distribution can be made. Moreover, in doing so, the main chassis units do not have to be disturbed, accessibility can be improved, and ample space exists for a power-steering unit.

This now brings us to the question of the legal effect of moving the front axle rearward and increasing its load from 5500 to 9000 lb.

To answer this question, it is necessary to study dimensions and load figures for vehicle combinations with both conventional and revised truck-tractor chassis. Fig. 1, therefore, gives dimensions for conventional truck-tractors with 35-ft semitrailers, with both single and tandem axles. The trailer axles are located so as to give a level load of 18,000 lb on the single axle and 32,000 lb on the tandem axles. Fig. 2 shows similar combinations except that the front axle on each tractor has been moved rearward and the fifth wheel moved forward to give a front-axle load of 9000 lb. (It will be noted that the additional payload thus gained on the fifth wheel requires an adjustment rearward of the trailer axles to maintain a level load. This is a step in the right direction in those states having a bridge formula.)

Extra Weight Legal in All But 11 States

With the dimensions shown in Figs. 1 and 2, a study was made of the weight regulations in all 48 states. Fig. 3 summarizes these data. (In this graph, the zero line represents the conventional chassis.) The load increase or decrease with the revised chassis is shown for each state. It can be seen that the full increase in payload is legal with the single-axle trailer in all states except eleven. Of these eleven, nine allow considerably higher gross than the average state permits. With the tandem-axle trailer, the full increase is legal in seventeen states; 500 to 2900 lb is legal in four states; no gain is legal in fourteen states; and a

loss of 340 to 840 lb is suffered in fourteen other states.

There will undoubtedly be some concern over the states in which there is no gain, but it should be remembered that these figures are based on a combination length of 45 ft. Most states, however, have length limits greater than 45 ft, which would make possible substantial improvement. For example, of the fourteen states that show a loss, nine permit combinations to be 50 ft or longer.

It should also be pointed out that in those states where no gain is possible, there are other inherent advantages in the revised chassis design. No longer would it be necessary to load precisely the tractor rear axle and trailer axles to the limit. The front axle could easily carry 1000 or 2000 lb of the weight normally carried by the tractor and trailer rear axles. In most cases, this would result in improved payload of 500 to 1000 lb, since it is doubtful if trailers could be consistently loaded to the precise limits of the axles.

In conclusion, it appears that through use of power steering, modifications can be made in chassis design that will permit a substantial increase in payload in most states.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

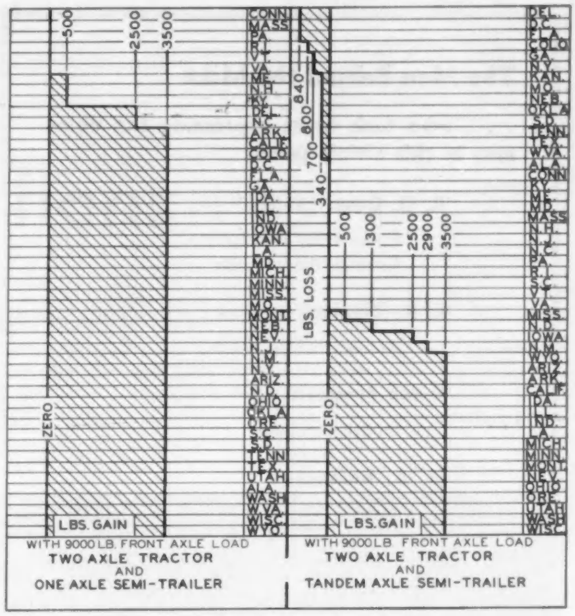


Fig. 3—By permitting front-axle load to be increased to 9000 lb, power steering makes possible a substantial gain in payload in many states

Excerpts from Discussion by . . .

Howard Willett, Jr.

Willett Trucking Co.

As a practical truck operator, I can agree with everything the author says about the desirability of:

1. Placing more weight on front axles to increase payload
2. Doing it by moving the front axles back
3. Giving the driver power steering to cope with his greatly increased steering burden.

At the present time, very few units carry the maximum payload allowed by the states through which they travel because they can't get enough weight up onto the front axle. The only units that do reach maximum front-axle weights are tractor-trailers designed and operated as a single unit—for example, petroleum tanks. However, integrally designed units cannot be used in many fleets because of the interchangeability necessitated by broker operations.

The problem of getting weight up onto the front axle is, of course, just a matter of getting the fifth wheel far enough ahead of the rear axle. The author has given us a solution for the tractor—one which would be simple if it weren't for the trailer.

There are two things about the trailer that limit the movement forward of the tractor fifth wheel. One is the tolerance necessary to prevent the front corner of the trailer from bumping into the rear of the tractor cab when making a turn or jackknifing. The other limit is the interference between the trailer landing gear and the rear of the tractor frame or the outside of the tractor rear tires. If the trailer landing gear is moved too far toward the rear of the trailer, it will not support the trailer while it is being loaded.

Shortening the wheelbase of the conventional tractor is a great help because it increases the effectiveness of each forward inch of fifth wheel movement from 100 to 140 lb.

The idea of moving the front axles back is equally applicable to a tandem-axle tractor where the same problem exists, namely, getting greater payload through maximum use of front-axle loading.

The author's solution is certainly a step in the right direction. But the maximum benefit can only be reached with the aid and cooperation of trailer manufacturers.

C. F. Hammond

Gemmer Mfg. Co.

Question: Why was only 9000 lb quoted for front-axle loading? Why not more?

Answer: Experience showed that a vehicle with 11,000-lb front-axle loading was not controllable during a blowout without power steering.

Pros and Cons

The Men Behind the Mike . . .

. . . who took turns expressing the opinions in this article were:

R. O. Doss, Leader
Fisher Body Division
General Motors Corp.

E. R. Ziegler, Secretary
Ainsworth Mfg. Corp.

Frank Nemeth
Studebaker Corp.

H. A. Bolenski
General Motors Corp.

L. H. Nagler
Nash Motors Division
Nash-Kelvinator Corp.

AUTOMOBILE manufacturers cannot discuss the whys and wherefores of their particular door constructions in exact dollars and cents. But they can speak of the pros and cons of door designs in terms of engineering and manufacturing problems encountered with them.

While all doors are inherently of multiple construction with inner and outer panels, reinforcements, clips, moldings, and so forth, they can be broken down into two distinct types—one-piece (integral upper frame) and two-piece (separate upper frame) construction.

The one-piece door has the inner and outer panels above the belt line integral with the panels below the belt. This construction requires an inside garnish molding around the daylight opening which serves as a finish molding and glass retainer. (See Fig. 1.)

A degree of simplification of the one-piece, integral upper frame door can be obtained by eliminating the garnish molding. The inner panel above the belt line is formed so that it can also serve as the finish molding. (See Fig. 2.) Although this offers a great advantage in simplification (with resultant economy), it also means that:

1. Masking is necessary when the interior above the belt line is painted a different color than the exterior.
2. Quality of finish requires cold-rolled steel for the inner panel and metal finishing to prepare surface for paint.
3. Precise dies are required for inner panel above belt.
4. Additional operations are required to form the return flanges.
5. Limitations are imposed on the use of special finishes, such as wood graining, around the interior daylight opening.

The two-piece, separate upper frame door is the kind used on a convertible up to the belt line. Above the belt line, the inner and outer panels and garnish molding can be replaced by a rolled steel or extruded aluminum section. This section can be bolted to the lower half of the door or in the case of a steel section could possibly be welded.

Following is a list of advantages claimed for two-piece door construction:

1. Permits greater degree of interchangeability between different body styles.
2. Simpler tooling with resultant economy—complex cam dies are not required to form upper frames.
3. Simplified door fits in both production and service—upper section can be fitted to body independently of main door panel.
4. Greater visibility due to narrower sections and overall pillar width.
5. Steel conserved—through more efficient use of blank size for inner and outer panels and possibility of substituting an extruded aluminum section for above the belt line inner and outer panels and garnish molding.
6. More efficient storage and handling of doors and panels in production and service.
7. Square corner styling motif is possible through use of mitered corners.
8. Makes possible use of a variety of finishes above and below the belt line (bright finishes with anodized aluminum, chrome-plated cold-rolled steel or stainless steel).
9. Permits a unitized assembly of ventilator, upper frame, glass run, and sliding glass which can be prealigned before installation into the door.

The disadvantages of two-piece design (separate upper frame) were said to be:

1. Overall unit cost is generally higher per door. Welding or bolting the upper frame onto the lower structure adds assembly costs.
2. Masking is required if interior paint color is to be different than that of the exterior.
3. Places limitations on lock design and minimum door thickness.

# of Door Constructions

Earl R. Ziegler, Ainsworth Manufacturing Corp.

Based on secretary's report of discussion at Round Table on Pros and Cons of Door Constructions held at the SAE Summer Meeting, Atlantic City, June 8, 1953. Chairman was R. O. Doss, Fisher Body Division, General Motors Corp.

4. Puts restrictions on stlying—corner radii cannot be less than minimum permissible for bending unless mitered and square.
5. Difficult to obtain pleasing appearance at juncture of upper frame and belt.
6. Special conideration must be given in design to obtaining a seal at the belt line.
7. Corner filler is required at nose of vent if a round corner is desired.

In the final analysis, economics is a major and perhaps controlling factor in selecting type of door construction to use. Manufacturing costs for the desired appearance and quality of finish and structure may vary considerably with different production rates, floor space, available equipment, and methods of manufacture. In general, however, the two-piece door (with relatively high cost per unit but with low tool cost) is most economical if produced in low volume. With high volume production, the integral door (with high tool cost and low unit cost) will probably prove to be most economical.

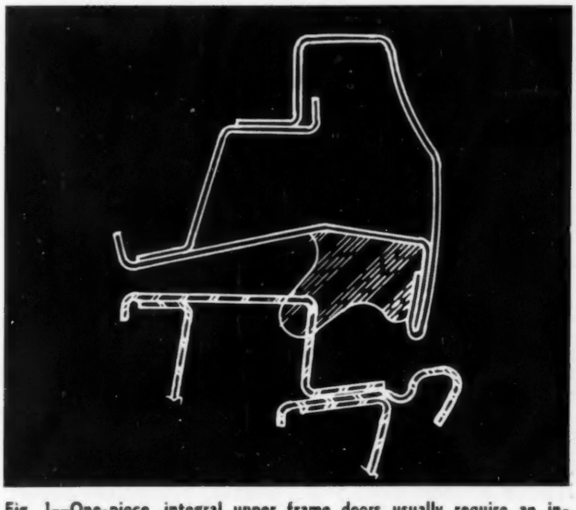


Fig. 1—One-piece, integral upper frame doors usually require an inside garnish molding around the daylight opening. This serves as a finish molding and glass retainer

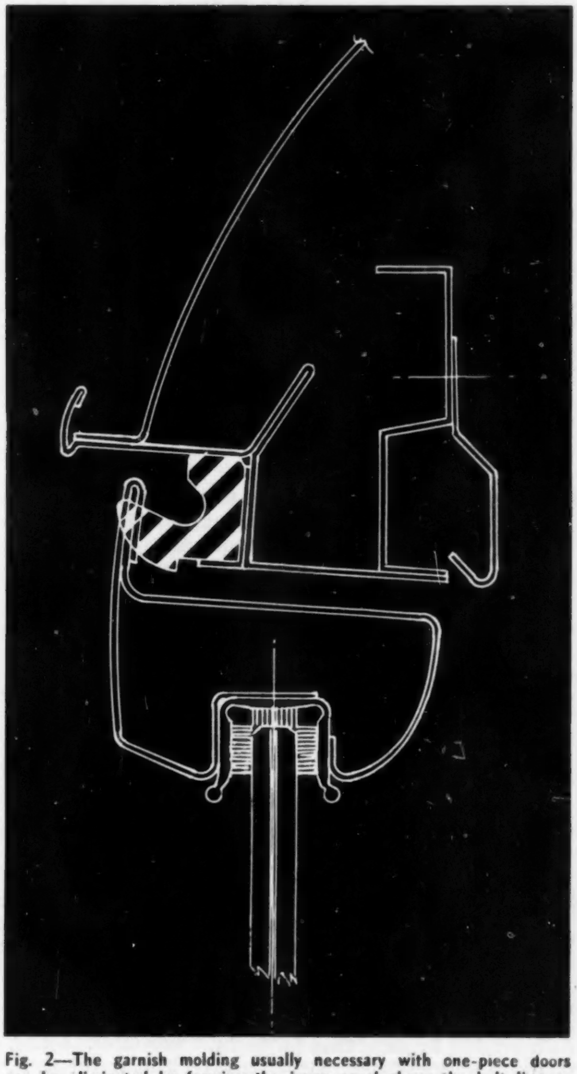


Fig. 2—The garnish molding usually necessary with one-piece doors can be eliminated by forming the inner panel above the belt line so that it can also serve as the finish molding

Plastics In Cars . . .

where they're used and why

R. E. VanDeventer, Packard Motor Car Co.

From report on Round Table* on Plastics as an Automotive Engineering Material, held at SAE Summer Meeting, Atlantic City, June 9, 1953.

These Plastics . . .	Are Used in These Parts . . .	Because of These Properties
1. Acrylics	emblems and medallions on horn buttons, hoods, rear deck lids	clarity, brilliance, outdoor durability, and ability to be embossed to give three-dimensional effect
	tail light lenses, edge-lighted dials, and light piping	unique optical properties
2. Cellulose Acetate Butyrate	radio grilles, arm rests bases, ash tray housings, knobs, and steel-cored steering wheels	less costly than acetate, available in wide color range, good stability under interior conditions, adequate toughness, and adaptability to various fabricating techniques
3. Vinyls	convertible rear windows, wire insulation, sealing strips, coated fabrics	excellent durability, outstanding appearance (embossed designs give new effects); plastisol vinyls are good dust and moisture sealers, expanding 50 to 75% in volume with heat application
4. Nylon	upholstery fabrics, speedometer gears, automatic transmission governor gears, door latch parts, and bushings	outstanding wear resistance, low coefficient of friction, operate without lubrication, can take wider tolerances than metal parts without lowering performance, can be produced economically by injection molding
5. Reinforced Plastics (Glass-reinforced polyester resins)	body parts	weight saving of over 40% as compared with metal parts, for limited production parts, costs may be competitive with conventional steel construction. (More has to be learned about production techniques and fastening methods.)
6. Phenolics	distributor rotors and caps, junction blocks, and body parts, and chassis parts such as timing gears	strong, hard, resist shock, excellent electrical properties, resist heat and cold as well as oil and acids

* (Leader of the Round Table on "Plastics as an Automotive Engineering Material" was C. F. Nixon, General Motors Corp. Serving with him were: R. E. VanDeventer, secretary, Packard Motor Car Co.; J. T. O'Reilly, Ford Motor Co.; Travis Meister, Kaiser-Frazer Corp.; A. Carter, Chrysler Corp.; Parke Woodworth, E. I. duPont de Nemours; and H. D. Thompson, D. G. Products Corp.)

from the Sections

President Robert Cass rapidly made the rounds of some more Sections before retiring as the Society's 48th president. Among the reports of his recent visits received so far are those from the Dayton, Cincinnati, St. Louis, Indiana, and Washington Sections.

The close of 1953 also brought 35- and 25-year certificates to many additional members. Among the Sections reporting "old timers" and "pioneer members" this month are: Northern California, Milwaukee, New England, Southern New England, Cleveland, St. Louis, Mid-Michigan, and the South Bend Division of Chicago Section.

Buffalo

Field Editor
D. I. Hall
Nov. 12

DEVELOPMENT of a breeder-type reactor is the primary endeavor of the Dow-Edison group, one of five industrial study groups in the **nuclear power** field. Walter E. Donaldson, production development engineer, Dow Chemical Co., said a breeder-type reactor would convert all the **natural uranium to fission** products and do it faster than the products are burned. "In other words, we must have our heat for power, plus saleable fission byproducts." Thus, breeder-type reactors could supply fission products for portable installations and thermal reactors.

Donaldson said thermal reactors may **produce ten times** as much power as the breeder type, but they are able to convert just a small percentage of natural uranium to fissionable material, the remainder being wasted.

The Dow-Edison group doesn't feel the thermal reactor is good enough to be the basis of industrial developments. "To be reasonably certain of raw material supply **in time of war—when power is needed more than ever—we feel it is necessary to have a breeder that would operate on residue from current operations rather than to** require dependence on foreign resources."

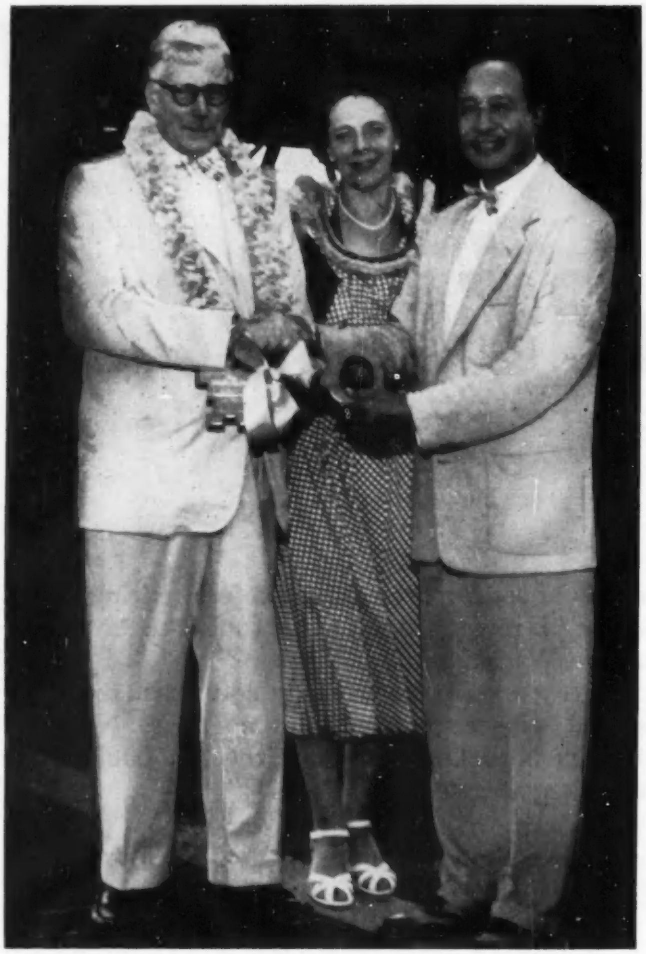
Donaldson pointed out that enrichment substances provided by the government to encourage research are priced at unrealistically low figures and are **tax-consuming** rather than tax-paying. The Dow-Edison group feels that the development of a profit-making, tax-paying, nuclear powerplant that can compete with coal or diesel installations is the only practical approach to nuclear power. And the group believes that the breeder-type reactor is the best solution at this time.

Cleveland

Field Editor
W. B. Fiske
Nov. 9

FULL-SCALE CRASH studies that have been made with old Air Corps cargo planes so held the interest of members, that the speaker was asked to continue for another half hour. He was I. Irving Pinkel, associate chief in the Physics Division, NACA Lewis Flight Propulsion Lab.

Pinkel told members that six tons of instruments were installed aboard the planes to detect **combustible atmosphere** and to gain a time-temperature history where



When President and Mrs. Robert Cass flew from Oahu to the island of Hawaii, they were met by Section officials and local celebrities headed by James Kealoha, mayor of Hilo (right).

From Section Cameras

Echoes From Cass Hawaiian Visit

When President Cass spoke at Hilo Division of Hawaii Section, he was welcomed and introduced by William R. (Babe) Chillingworth, vice-chairman for Hawaii.

fire occurs. Movie cameras were set up around the crash area, a helicopter took pictures from above, and photos were taken inside the plane as well as outside.

The crashes were made to simulate those that occur in landing or take-off, and planes were guided by rail into crash barriers.

To determine **ignition sources** and the effect of fuel spillage, the conditions were varied. Not only does fuel spill, but it atomizes quickly into mist. The mist is first swept back and then surges forward as the plane decelerates.

Movies were shown and Pinkel used plane models to explain ignition sources and points of greatest hazard.

Robert E. Cummings, past chairman of the Section, was awarded a certificate for outstanding leadership, and Leo L. Williams received a 35 year certificate. Members who received 25 year awards were: Howard A. Reinhart, Dayton H. Robinson, Kimball D. Smith, S. Harold Smith, G. M. Sprowls, Theron D. Stay, Henry D. Stecher, R. K. Super, Thomas Barish, Forest S. Baster, Ernest G. Boden, Gerald C. Frank, Laurence K. Jenkins, E. W. Krueger, George M. Lange, and Donald W. Randolph.

By the way, as part of a TV series in Cleveland, SAE was in the spotlight on December 13. The programs are presented by the Cleveland Technical Societies Council to interest young men and women in engineering careers.

Northwest

Field Editor
W. M. Brown
Oct. 9

ENTHUSIASM developed at the Northwest Section field trip to the Titan Chain Saw plant. A near record turnout viewed the complete manufacturing facilities of one of the leading chain saw manufacturers of the country.

After the plant tour there was a live demonstration of a Mighty Midget in action on a northwest log, followed by the serving of coffee and doughnuts by the saw company.

Nov. 6

EXPERTS TWENTY YEARS AGO had no idea of the dynamics of the motor vehicle. They just didn't know we would need as many highways of the types being built today. Thus William A. Bugge described the origin of some of the problems facing Washington State highway planners. Bugge is Director of Highways, Washington State Highway Commission.

"Automotive design may jump ahead of advances in highway design for a short time," he said, "but inevitably **highway design** must catch up. Roughly, over a relatively long period of time, advances in both automotive and highway design move parallel to each other."

Bugge said he was afraid "all this talk will have the same effect as it did on a man who was hard of hearing. . . "

After years of putting up with the handicap, a man who was hard of hearing went to a doctor. The doctor examined him and said, "I think you are drinking too much."

"How is that, Doc?"

"You are drinking too much!"

"Maybe I am."

"Well, cut it out and see if you can't hear better."

Six weeks later, he came to see the doctor and was hearing perfectly. Six weeks still later, the man came back and couldn't hear a thing.

"I thought when you had stopped drinking, you were hearing all right."

"I was Doc, but I liked what I was drinking so much better than what I was hearing, I went back to drinking again."

Mohawk-Hudson

Field Editor
Lewis F. Smith
Nov. 10

DIFFERENT TYPES OF OIL fulfill four main functions: lubrication, cooling, sealing, and cleaning. R. W. Flynn, senior staff engineer for Gulf Oil Corp.'s New York Division, explained these functions in his talk, "Modern Lubricating Oils for Modern Internal Combustion Engines, Cars, Trucks, and Buses."

New American Petroleum Institute designations were explained along with **service characteristics** of each oil. Flynn also described seven types of oil for automotive fleet application. Their uses depend upon characteristics of individual engine design, fuel used, and the fleet operation schedule. Flynn said there are as many opinions regarding the use of a particular oil as there are on religion or politics.

Dayton

Field Editor
P. J. Long
Nov. 17

THE YOUNGER ENGINEERS should be re-examining the basic training they have had and see that they avoid the danger of **too much specialization.** They should also take seriously to heart the need for rechecking their basic knowledge of management and its problems, taking definite steps to expose themselves to it. That was President Robert Cass' suggestion at the November meeting of the Dayton Section.

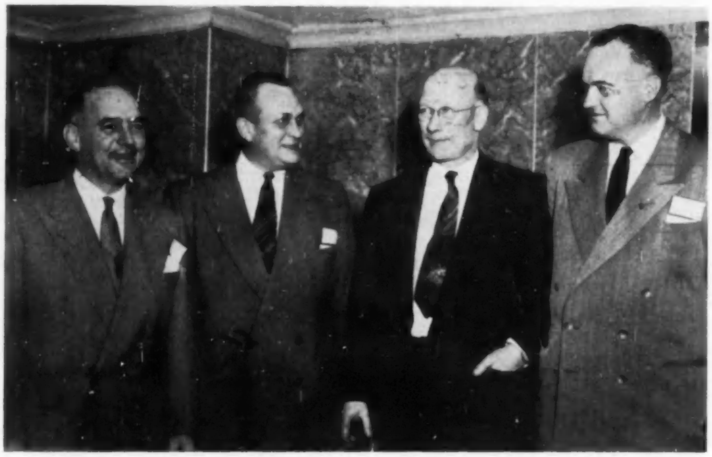
"In the past, most engineers, while not necessarily

Central Illinois (Nov. 12)

From Section Cameras

Getting Together at a joint meeting of the SAE and ASME are: (l to r) R. L. Sullivan, ASME Section chairman; Professor Earle Buckingham, speaker; John E. Jass, technical chairman of the session, and R. E. Kennemer, SAE's Section chairman.

Canadian (Dec. 3)



Pleasant Moments at the meeting in St. Catharines, Ontario, will be remembered by: (l to r) George A. Stauffer, president of Thompson Products, Ltd.; J. W. Primeau, president of Hayes Steel Products, Ltd.; Chairman A. A. Scarlett; and E. H. Walker, regional vice-chairman of the Section, Niagara Peninsula.

South Bend Division of Chicago (Nov. 16)

For 35 Years of membership in SAE, Frank C. Mock (extreme right) is awarded a 35-year certificate. W. A. Gebhardt, vice-chairman of the Aircraft Activity of the Chicago Section, hands the certificate to Mock. Applauding are: (seated l to r) C. J. McDowell, Allison Div., GMC; and W. W. Smith, Studebaker Corp.

anti-social, have not necessarily been responsive or fully informed of the Management's side . . . and, therefore, have not so readily been recognized as top **executive material.**"

He said that few engineers can read, understandingly, detailed financial statements, but they should consider that knowledge as part of **their responsibility.**

". . . I think the time has come for us . . . to make it a part and parcel of our engineering development to become acquainted with material costs, with the source of money making possibilities, the competing **claims of budgets** in all areas of the company, and armed with that knowledge see that proper emphasis is given to research in the most economical manner." Everyone agrees that the world in which we are moving will see revolutions now being conjured up by the scientists and that they call for engineering to assume much greater importance in our world."

Hollister Moore, Manager of the SAE Sections and Membership Division, was with the president. He gave a short talk about the work of his division.

Dec. 9

SPEAKING at the Section's December meeting, Robert T. Jackson pointed out that at the Indianapolis Race, the solid-type front axle is preferred in racing design—not the **independent front suspension.** He also said that a differential is not normally used. Using color slides to supplement his talk, Jackson covered the design and construction of **racing car bodies,** frames, front and rear suspensions, quick-change rear axles and engines. He stressed the popularity of the Kurtis-Kraft cars and the Meyer-Drake engines in the race.

Jackson is sales engineer for the Perfect Circle Corp. He has had over **twenty years of experience** in the design, construction, and maintenance of racing cars, including dirt track, and speedway types. He was on the crew that ran the Maserati, which Wilbur Shaw raced to victory in 1939 and 1940. He has proved a popular speaker with SAE members, having previously spoken at the Milwaukee and Central Illinois Sections.

A social half-hour for members was sponsored by the Dayton Forging & Heat Treat Co.

Salt Lake

Field Editor
Fred Blatz
Nov. 9

GET THE MACHINE in order before winter gets the machine. This was the advice given by J. A. Miller, research engineer with the California Research Corp.

The development of **winter grade oils** has helped to do away with starting troubles. Miller pointed out that modern winter grade 5W motor oils will do an excellent job of lubricating. He said that the engine operator must overcome fear of using these light oils and that the only problem (one of minor importance) is **increased consumption.** He said, too, that winter grade oils can be used for all types of heavy-duty gasoline and diesel engines.

Twin City

Field Editor
S. H. Knight
Nov. 12

FUTURE MOTORISTS will get more light and better light according to Allan L. Johnson. Johnson is an SAE Lighting Committee member.

Production of the new sealed beam headlights is awaiting only necessary changes in state laws to permit general use of the lights. These will give **30% more light** on low beam, be effective at 100 ft greater seeing distance, and will also be much **more effective in rain,** fog, and snow and—there won't be any glare.

Johnson said present sealed beam lights are outmoded for present car speeds and do not show objects far enough ahead. They diffuse the light—too often as glare into the eyes of approaching motorists.

He also revealed that an SAE committee is now working to improve **rear lamp lighting** on passenger cars and trucks.

Southern New England

Field Editor
A. D. Nichols
Nov. 4

PROGRESS has been very rapid in the development of titanium, zirconium, vanadium, and their alloys. This is so mainly because they possess unusual properties which assure them prominent places among **structural materials.** Dr. Heinrich Adenstedt pointed this out at the Section's November meeting. Adenstedt is staff metallurgist in the newly formed gas turbine department of the Lycoming Div., AVCO Mfg. Corp.

He said excellent **corrosion resistance** insures a broad future for titanium, and it is very common in nature as ilmenite or titanium oxide. Only iron, aluminum, and magnesium are more plentiful. Titanium is 16 times more plentiful than chromium, 400 times more than nickel, and 800 times more than copper.

However, it is difficult to **produce commercially.** Attempts to reduce titanium oxide were made many years ago, but not until 1910 was ductile titanium produced in a laboratory. Because of its great affinity for oxygen

Cincinnati (Nov. 16)

Conducting The Show is President Robert Cass, (standing) speaker at the dinner-meeting. At the table are: (l to r) Cliff Duhme, treasurer; Bill Kimsey, chairman of technical activities; Holly Moore, Manager of the Sections and Membership Division, New York City headquarters; Cass; John Behne, chairman; John Scanlon, chairman of the Program Committee; Lee Myers, chairman of the Membership Committee; and Bill Meyers, chairman of the Attendance Committee.

From Section Cameras

Southern California (Nov. 12)

Good Jet Transports should cost no more to operate than present types, says Discusser C. L. "Kelly" Johnson. Listening intently are Carlos Wood (left), Chairman Jack Findeisen, and Speaker Harold Hoben.

and nitrogen, titanium must be melted in an inert atmosphere. Special crucibles must be used because of this and also because of its high melting point.

Manly award winners, Bruce E. Miller and Robert E. Gorton, were honored at this meeting. Hollister Moore from the New York office was on hand and Robert E. Johansson spoke about the work done by C. M. Manly, SAE president in 1919.

Manly was author of the first aircraft standards. The memorial award bearing his name was established in 1928, a year after his death. It is given annually to the author of **the best paper** relating to theory or practice in the research, design, or construction of aeronautic power plants, parts, or accessories.

Gorton and Miller were authors of a paper on instrumentation of an aircraft powerplant to determine vibration, amplitude, accelerations, decelerations, and temperatures of the various parts of the engine. (The paper is, "Instrumentation for Aircraft Gas Turbine Development" and is published on p. 650 of the '53 SAE Transactions.)

Hollister Moore gave 35 year certificates to R. Leon Smith and John M. Collins, and a 25 year certificate to Arthur W. Soutter. Certificates were also awarded posthumously to Dwight R. Judson, 35 years, and Charles W. Smith, 25 years.

Dec. 3

AN IMPROVED automotive diesel combustion system as used on the new Mack engine was the topic of Bruno Loeffler. He is executive engineer in the Engine Division of Mack Motor Truck Corp.

Loeffler said that the user of the new engine should be able to **save 15–20%** of his fuel bill, as compared with the best diesel experience. He said that the operational range is from 1400 rpm to 2000 rpm, without excessive smoke and engine knock.

The engine is of the open-combustion-chamber type. This chamber is located in the piston crown and is of the so-called **"Mexican hat"** design. The center section of the piston, just below the nozzle, is formed like a raised cone. The nozzle is off center and slightly inclined. Valves are not masked as the swirl is induced by a restriction in the valve port.

South Bend Division of Chicago

Field Editor
D. W. Miller
Nov. 16

AN IDEAL ENGINE cannot become a reality until accurate information on engine characteristics is available to the control designer. As a step in this direction, Bendix Products has developed equipment which determines, rapidly and accurately, the real location of the compressor stall area.

J. W. Kunz, Jr. discussed the design, development, and practical application of this **special equipment** in his paper, "A New Technique for Investigating Jet Engine Compressor Stall and Other Transient Characteristics." Kunz is chief engineer of electronics, Bendix Products Division, Bendix Aviation Corp.

Compressor stall, an undesirable trait of the axial-flow compressor used in **today's jet** engine, is defined as a drastic reduction in the compressor air delivery which occurs when the back pressure exceeds some critical value.

Kunz elaborated on techniques used in **evaluating compressor stall** areas as well as the various factors affecting compressor stall regions. In summary, he drew forth the following major conclusions:

1. Location of the compressor stall area is influenced by the way the engine is accelerated.
2. Inconclusive information is available on changes in location of compressor stall at various inlet air temperatures.
3. Compressor stall on the high rpm side is most violent. Under certain conditions, it can be combined with rich blowout.
4. The universal fuel control and related instrumentation provide an efficient method for determining new engine fuel-flow characteristics and has displayed a definite stall "notch" on engines tested to date.
5. It is impractical to operate a jet engine with fuel-flows scheduled very close to the stall area unless suitable compensation is made for the shift in the stall area location caused by throttle manipulation.

Metropolitan

Field Editor
Leslie Peat
Nov. 12

GAS TURBINE EXHAUST can be used in refineries, cooking and washing, for treating and vulcanizing rubber, operating drop hammers, presses, and hoists—among many other things. That's what G. B. Hatch told "Met" Section members. Hatch is with the General Electric Co. in Schenectady, N. Y.

"Each application should be carefully studied from the standpoint of economics and **practicability.** The gas turbine will probably never replace all other prime movers but successful uses of this power source, together with its recovered process steam, indicate that it has a huge future."

Both Hatch and J. M. Pederson (also with GE in the Aircraft Gas Turbine Division, Cincinnati) predicted a bright future for the jet engine in the air and on land.

Pederson said level flight speeds over the speed of sound are accomplished regularly and that engines are being developed which will push aircraft to twice the **speed of sound** and even further.

"Our next barrier is thermal and the industry is vigorously attacking the problem of high surface tempera-

From Section Cameras

Mid-Michigan (Nov. 16)

Oldtimer Hector Rabezzana (left) received his 35 year membership certificate from Edward Holtzkemper, chairman of the Mid-Michigan Section. Rabezzana has his own manufacturing business with factories at Fenton and Lake City, Mich. He retired from the AC Spark Plug Division, GMC, in 1944 after 29 years as chief engineer of the spark plug department.

Northwest Section (Nov. 6)

The Northwest Section takes this opportunity to repudiate recent charges that three prominent Northwest Section members were observed shouting, "Get a Horse" at passing motorists on a downtown Seattle street. Reading from left to right the members in question are John G. Holmstrom, past chairman; Wallace M. Brown, field editor; and Robert C. Norrie, chairman.

Southern New England (Nov. 4)

Admiring the Manly Award is Robert E. Johansson, (extreme right) vice-chairman of the Section's Aeronautics Activity. Winners of the award for 1953 are: Bruce E. Miller (left) and Robert E. Gorton (center).

Having Fun are: (left to right) L. Morgan Porter, Section chairman; Dr. Heinrich Adenstedt, speaker at the meeting; and Dr. John C. Mertz, technical chairman.

tures with improved materials, better methods of construction and with cooling systems."

Indiana

Field Editor
W. A. Barnes
Sept. 10

THE OUTCOME OF WARS today is determined before the shooting starts—by engineers. That's what William B. Stout told Indiana members. Stout was one of two SAE past presidents at this meeting. The other was Ralph R. Teetor, who introduced Stout.

Stout said many engineers are not aware of the extent to which their work has not only advanced standards of living, but has also influenced the **course of history.**

Almost all advances in the general lot of mankind have come within the past five-hundred years, and the greater part have come within the past two-hundred years. The great turning point was the invention of the steam engine. This was the first major step in doing work without expenditure of muscular effort by men or animals. When a man's sole output is that of muscular effort, Stout said, his **time is worth less** than one-half cent per hour.

Oct. 8

TUBELESS TIRES will come into their own in both the passenger-car and commercial vehicle fields. Robert P. Powers made this prediction before the Indiana Section. He is head of the advanced engineering group, Firestone Tire & Rubber Co.

He spoke also about the increased speed of present-day passenger cars, and the accompanying increase of **heat build-up** in tires that causes blowouts. The heat build-up is caused by a **traction wave** that develops at car speeds of about 100 mph.

Films were shown of regular car tires being run at speeds of 100, 110, and 120 mph, and then of new improved tires run at the same speeds. The traction wave was considerably reduced in the second series of pictures.

Milwaukee

Field Editor
D. Roger Neeld
Nov. 6

"**. . . THERE IS** no such thing as a designer working independently of the production man or the metallurgist. To design, manufacture, and **sell a product** is the job of a team not a series of more or less independent actions by each specialist.

"The designer may do a perfect job of **functional designing,** but this is of no avail if the material and processes by which it is made, price it out of the market.

"A designer cannot know as much as a metallurgist about metals and how they are processed. In this **day of specialization,** it is hardly possible to devote enough time to even read all that is current on any but one branch of metallurgy."

An award went to R. K. McConkey in recognition of his fine work as chairman throughout the 1952–53 season, and membership certificates were given to: E. T. Foote, for 25 years; Wilfred G. Coles, L. M. Kanters, J. George Oetzel, and Henry T. Thorkildsen for 35 years in the Society.

Colorado

Field Editor
P. G. Anderson
Oct. 26

WHY THE TWELVE VOLT system is the most practical approach toward better ignition, generator and **cranking motor performance,** and better electrical distribution was explained at this October dinner-meeting. Herman Hartzell, assistant chief engineer with the Delco-Remy Division of GMC, presented his second paper on this subject. This contains information on developments that have taken place since the first paper was presented a year ago.

Northern California

Field Editor
R. Gray
Oct. 28

PREIGNITION was the subject presented by Donald R. Diggs. His theme was taken from, "An Investigation of Preignition in Engines," a paper given at SAE's 1953 Summer Meeting. Its authors are Diggs, A. O. Melby and B. M. Sturgis, all of du Pont's Petroleum Lab.

Diggs explained that preignition is usually accompanied by identifying noises from the engine, but this is not always the case. **Silent preignition** causes severe damage because there is no warning.

"The ability of deposits to induce preignition arises from **localized high temperatures** which are developed through the combustion of carbonaceous material in the deposit structure. The burn-off of carbonaceous material is promoted by the salts of lead and other metals and is influenced markedly by engine conditions. . . ."

He said, too, that increased compression ratio, super-

charging, operation with retarded spark timing, and the combustion of **lean mixtures** are all likely to increase the tendency for preignition.

Old timers (members for more than 25 years) received certificates during the meeting, and, incidentally, Northern California can expect to break the heavyweight class of SAE Sections with an addition of just ten more members.

Pittsburgh

Field Editor
O. B. Rosstead, Jr.
Nov. 24

FATIGUE is often diagnosed as a bond failure in bearings, H. W. Luetkemeyer told members. Luetkemeyer is vice-president and mechanical engineering director of the Clevite-Brush Development Co., a division of the Clevite Corp.

He said that a good test consists of rubbing the fractured surface of the bearing with a common eraser. **A bright surface** indicates fatigue, a dull or gray one indicates bond failure.

Speaking about corrosion, Luetkemeyer said it is similar to fatigue also—visually. However, corrosion appears all over the bearing rather than in spots and is confined largely to copper-lead and cadmium **alloy bearings.** Where corrosion of copper-lead bearings is in question, he suggested breaking the bearing and examining the color of the fractured surface. A red surface indicates corrosion and a gray one indicates no corrosion. If a sample of the lubricating oil has been held, an analysis showing a **high neutralization** number and copper-lead or iron compounds, corrosion has taken place.

Western Michigan

Field Editor
C. E. Messner
Oct. 20

" . . . **NO FIELD** of activity today offers more opportunity for new developments and sales efforts than that of **hydraulic transmission** application." That's what J. W. Crooks told members at this meeting. Crooks is sales representative for the Allison Division of GMC in Indianapolis.

He said that the effect of the hydraulic transmission on the passenger-car industry has been "noteworthy." In heavy-duty commercial and military equipment, it has provided, "a way of **producing more work** than ever thought possible with conventional design."

There are several reasons why converters have not been universally accepted in industrial equipment of all sizes—natural **public resistance** to change and incomplete understanding of the factors affecting converter application. Because of comparatively low volume, the higher first cost has restricted its use to larger and more expensive equipment.

However, Crooks said, there is every reason to believe that **universal acceptance** of torque converters will occur in the near future. This will be due not only to greater public acceptance (and understanding) but also because:

1. Factual field data evidence of **converter advantages** will increase in amount and more generally prove its worth.
2. Owners of equipment will become more and more conscious of the reduced operating costs which result from using converters.
3. In the new buyer's market, equipment manufacturers will be required to offer the converter as a means of obtaining new sales features and **operational advantages.**
4. Converter manufacturers will continue to make improvements, add to their product lines, and attempt to **reduce costs** as the effect of increased volume becomes apparent.

Canadian

Field Editor
F. G. King
Dec. 3

THE IMPORTANCE of tool engineers has been recognized by the large industries. These industries are attempting to insure that **future demands** for such engineers will be met. This is what Ivan S. Kaye told Canadian Section members at the December dinner-meeting. Kaye is superintendent of the Anti-Friction Bearing Division, McKinnon Industries, Ltd., and McKinnon Industries is a subsidiary of General Motors.

At the General Motors Institute, Kaye said, **a new course** in tool engineering is available. A degree of Industrial Engineering is granted.

Tool engineers are, " . . . the men who devise more **effective manufacturing** methods, better plant layouts, better machines, tools, materials, and so on."

St. Louis

Field Editor
A. W. Zub
Nov. 18

BY 1960 there will be 13,000,000 more people. This was the prediction of President Robert Cass.

Cass said this increased population will have a great effect on our supplies of material. "We need **new materials** and must make old ones do new jobs." For ex-

ample, aluminum is now taking on many jobs formerly done by copper, as in electrical wiring and in radiators.

Speaking about **management,** the president said engineers should be given more opportunity to lead their companies. Laywers, marketeers, and comptrollers are always well represented, he said, and usually have their own way in forming policy.

While at the meeting, Cass gave a 35-year certificate to P. B. Postlethwaite and 25-year certificates to J. C. Blaine, G. C. Davies, and G. L. Gaston. A plastic cube memento was given to G. P. Dorris from the Section.

Hollister Moore, SAE Manager of the Sections and Membership Division, was also at the meeting and introduced Cass to St. Louis members.

Wichita

Field Editor
W. E. Shelor
Nov. 18

HUMAN NATURE and personalized control are very important in aircraft manufacture, according to Del Roskam vice-president of manufacturing, Cessna, who was the first of three speakers at this meeting. Roskam emphasized the growing importance of cooperation and coordination between **engineering and manufacturing** departments.

Beech's chief metallurgist, Art Lippitt, talking about copper brazing, showed photographs of many **practical applications** of this procedure.

Jack Smith, Boeing's assistant superintendent of tool fabrication, talked about fabrication of **plastic parts** for aircraft. Reinforced fiber glass, he said, permits production of complicated parts faster and easier. Talking about the application of plastic tooling, he emphasized advantages of speed, weight, and simplicity.

So great was the success of this meeting, that similar meetings are being planned for the future.

Texas Gulf Coast

Field Editor
W. B. Tilden
Nov. 13

TUBELESS TRUCK TIRES show promise for the future, T. A. Robertson told members at this meeting. Robertson is with the Tire Engineering Division, The Firestone Tire & Rubber Co., Akron, Ohio.

He said that two tubeless truck tires now being tested are: a conventional design for use on existing rim contours with a sealing gasket, and an entirely new design for use on a special one-piece drop center rim. The new tubeless truck tire will provide:

1. Greatly **reduced assembly weight**
2. Simplified rim construction
3. Easier mounting and dismounting, and
4. A measure of **puncture protection**

Passenger tires without tubes are increasing in popularity. Advantages of these are: reduced weight, improved riding comfort, high speed performance and ability to seal nail punctures.

New materials have come into the picture, too, and include super abrasion carbon blacks, nylon, extra strength rayon, and wire cords.

Southern California

Field Editor
W. E. Achor
Nov. 11

HAROLD HOBEN'S SURPRISE answer to the question of turbojets versus turboprops was "neither."

Studies he and William Lawrence have made for American Airlines led him to favor the ducted fan as the best type for first **turbine transports.** His objections to the turbojet are high fuel consumption, low take-off thrust, and noise. Objections to the turboprop are control complexity and cabin noise.

Discussers Carlos Wood, C. L. Johnson, and George Snyder—all aircraft designers—bet against **the ducted fan,** however. They doubted that this type of turbine engine would be available in the forseeable future because there's no military money behind its development. The trouble with the ducted fan, they said, is that its efficient operating range is too narrow.

New England

Field Editor
E. F. Donahue
Dec. 1

IMPROVED REFINING METHODS have enabled us to obtain greater quantities of premium grade fuel without increasing cost. That's what Dr. R. W. Scott told members. Scott is a group leader in the Research Division of Esso Laboratories.

Advancements made during the past 25 years in engine design and fuel quality were also reviewed. As for **future aspects,** a film was shown of engine development that will make possible use of fuels over 90 octane regular grade and nearly **100 octane premium** grade—in about 10 years.

In the absence of Chairman Reginald H. Robinson, Vice-Chairman Gustav Heiber presented 35 year membership certificates to: Dean Fales, C. F. Taylor, and Earle Buckingham. Twenty-five year certificates were presented to: James F. Shannon, H. B. Hawk, Wilbur

R. Morehouse. (Chairman Robinson is recuperating from pneumonia.)

Detroit

Field Editor
W. F. Sherman
Nov. 16

IGOR SIKORSKY, "father of the helicopter," predicted 100-seat 'copters will be available in a few years.

Sikorsky foresees development of **helicopter commuting** and short-haul service similar to that begun in Brussels and several American cities. But, the 'copter is not intended to replace either the airplane or the automobile. He said the use of faster planes for major inter-city hauls means the use of **longer runways** and longer clear approaches. Thus airports must be further from the centers of cities.

Lt. Walter Albert of Grosse Ile Naval Air Station was dinner-speaker at the Section meeting. Albert spoke about "odd jobs" done by Air Service personnel with helicopters and described a spectacular rescue of fishermen from ice floes in Lake St. Clair.

Cincinnati

Field Editor
E. B. Lohaus
Nov. 17

STOCKPILING procedures may tend to create an artificial shortage, but in some materials the **stockpiling program** makes sense—for those materials not produced in this country. This is what President Robert Cass told members at the November meeting.

"Nickel is in **short supply** for our needs without stockpiling and, therefore, engineers have a real problem facing them."

He said that Washington is hoping that some less critical substitute for nickel can be found which would be suitable for use as an alloying element by the aviation industry. It is also hoped that a way will be found to get high nickel bearing scrap directly to the producers of such items as jet planes and rotors.

Cass then stressed the part engineers should play in management. He said that in the world into which we are moving it is obvious that the engineer's work becomes so increasingly important that they should be well versed in subjects besides engineering. This will enable them to take the necessary responsibility to see that proper use is made of those things that come from their basic work."

Central Illinois

Field Editor
W. J. Lux
Nov. 12

IMPROPER USE of close dimensions can greatly magnify production costs. That's what Professor Earle Buckingham of M.I.T. told members in presenting his paper, "Dimensions and Tolerances." Buckingham spoke before a joint session of the SAE and ASME.

He also discussed problems of correlating **design and shop practices** to obtain both proper operation and economical production of machinery. Technical chairman of the meeting was John E. Jass, chief engineer at Caterpillar Tractor Company's Peoria plant.

Mid-Michigan

Field Editor
C. A. McKinney
Nov. 16

A DOUBLE FEATURE movie program was presented: "Haulaways West" and "McGurk Way." Sound like westerns? Well, they're not.

The first film concerns a shipment of automobiles being sent from Detroit to the West Coast. Problems of **driver efficiency** on long hauls and handling of vehicles are included.

"McGurk Way" depicts advances and **developments in transportation.** The film was produced for the Fruehauf Trailer Co.

Richard L. Hardgrove was guest speaker and presented his paper, "Truck Fleet Operation." Hardgrove is vice-president of Liberty Highway Co. in Toledo. He is an active and prominent member of the American Trucking Associations, Inc., the National Association of Purchasing Agents, and the Ohio Trucking Association.

Rochester Division of Buffalo

Field Editor
E. F. DeTiere
Nov. 18

FUTURE IMPROVEMENTS in engine performance and efficiency were discussed by D. F. Caris at this meeting. Caris is head of GMC's Research Laboratories Division in Detroit.

He said that these improvements will revolve around higher **compression ratio,** reduction in weight, and engine transmission relationships.

The pros and cons of the **gas turbine engine** were also explained, as well as advantages in safety and performance which make higher horse power engines desirable today.

SAE Section Meetings

Baltimore—Jan. 14

Chevrolet Plant. 5:30 p.m. Tour of plant on Broening Highway, Baltimore, Md.

Buffalo—Jan. 14

Hotel Sheraton. Dinner 7:00 p.m., meeting 8:00 p.m. Power Devices in Automobiles—E. C. Horton, chief engineer, Trico Products Corp., Buffalo, N. Y.

Canadian—Jan. 20

Roof Garden, Royal York Hotel, Toronto. Dinner 7:00 p.m., meeting 8:00 p.m. Automotive Engineering as Applied to Agriculture—S. M. Young, chief engineer, International Harvester Co. of Canada.

Central Illinois—Jan. 25

American Legion Hall. Dinner 6:30 p.m., meeting 7:45 p.m. Powdered Metals—D. B. Martin and A. J. Langhammer, Amplex Division, Chrysler Corp., Detroit.

Chicago—South Bend Division—Jan. 25

La Salle Hotel, South Bend, Ind. Dinner 6:45 p.m., meeting 8:00 p.m. Lessons Learned and Problems Ahead in Automobile Air Conditioning—J. W. Duhn, assistant electrical engineer, Chrysler Corp.

Cincinnati—Jan. 25

Engineers Club of Cincinnati. Dinner 6:30 p.m., meeting 8:00 p.m. Molded Fiberglass Car Body—R. S. Morrison, president, Molded Fiberglass Sheet Co., Ashtabula, Ohio.

Cleveland—Jan. 18

Allerton Hotel. Dinner 6:30 p.m., meeting 7:30 p.m. Pre-Ignition—R. F. Linch, Sun Oil Co., and P. A. Bennett and L. R. Landis, General Motors Research Laboratories Division.

Detroit—Jan. 25

Small Auditorium, Rackham Educational Memorial Bldg. Junior Group Meeting 8:00 p.m. Photography in Automotive Engineering — James Chandler, Ford Motor Co., E. B. Rifkin, Ethyl Corp., and Frank Thomas, Chrysler Corp. Moderator James Pilz, Timken Roller Bearing Co.

Detroit—Feb. 1

Rackham Educational Memorial Bldg. Meeting 8:00 p.m. Panel meeting on New Techniques in Sheet Steel Processing. (5 speakers)

Automation in Stamping Plants. A. J. Hole, general manager, stamping department, Ford Motor Co. Drawing Requirements of Cold Rolled Sheets—J. F. Brick, quality control, Hamilton plant, Fisher Body Div., GMC. High-Strength Low-Alloy Steel for Plated Parts—C. L. Altenburger, research metallurgist, Great Lakes Steel Corp. Flat Polishing, Coating, Stamping and Plating—A. Zimmerman, chief engineer, Micro-Polish Div., Murray Way Corp. Quality Control of Cold Rolled Sheet Steel—E. F. Lundeen, Assistant superintendent, Quality Control Dept., Inland Steel Corp.

Metropolitan—Jan. 7 and Jan. 20

Jan. 7—Brass Rail Restaurant, Fifth Avenue and 43rd Street. Dinner 6:30 p.m., meeting 7:45 p.m. Diesel Fuels of the Future—W. H. Hubner, Ethyl Corp., moderator. Navy Diesel Fuels—Harry King, Bureau of Ships. Railroad Diesel—W. K. Simpson, Electromotive Div., General Motors Corp. Automotive Diesels—L. J. Grunder, Richfield Oil Corp.

Jan. 20—Engineering Societies Building, 29 West 39th Street, New York, Fifth Floor. Meeting 7:45 p.m. Conversion and/or Design of Automotive Engines for L. P. Gas—W. A. Howe, Gulf Oil Corp., Pittsburgh.

Mid-Michigan—Jan. 25

Owosso City Club. Dinner 7:00 p.m., meeting 8:00 p.m. Unitized Construction—Larry Nagler, staff engineer, Nash-Kelvinator, Detroit.

Milwaukee—Feb. 5

Milwaukee Athletic Club. Dinner 6:30 p.m., meeting 8:00 p.m. The Perplexing Cam Engine—K. L. Herrmann, consulting engineer, Herrmann Engineering Co.

Mohawk-Hudson—Feb. 9

American Locomotive Co., Schenectady, N. Y. Dinner 6:45 p.m., meeting 8:00 p.m. Diesel Locomotive Maintenance—Stanley Lodge, Alco Educational School, American Locomotive Co.

Pittsburgh—Jan. 26

Mellon Institute. Dinner 6:30 p.m., meeting 8:00 p.m. Valve Burning—P. H. Richard, engineer, E. I. du Pont de Nemours & Co., Wilmington, Del.

St. Louis—Feb. 4

Engineers Club, St. Louis. Dinner 7:00 p.m., meeting 7:45 p.m. Space Travel—Wernher VonBraun, chief, Guided Missile Development.

Southern California—Jan. 21

Rodger Young Auditorium. Dinner 6:30 p.m., meeting 8:00 p.m. Truck and Bus Leasing vs. Company Ownership—H. L. Willett, Jr., National Truck Leasing System, and J. B. Clark, Superintendent, Maintenance and Purchasing, Asbury Systems.

Southern New England—Jan. 28

Bradley Field, Windsor Locks. Dinner 6:45 p.m., meeting 8:00 p.m. This Fantastic Engineering Era—A. T. Colwell, vice-president, Thompson Products, Inc., Cleveland, Ohio.

Spokane-Intermountain—Jan. 19

Caravan Inn. Dinner 6:30 p.m., meeting 8:00 p.m. The Man With One Thousand Hands, Kitimat Project. Speaker from International Harvester Co., Spokane, Wash.

Syracuse—Jan. 18

Museum of Fine Arts. Dinner 6:30 p.m., meeting 8:15 p.m. Engineering vs. Styling of Automobiles of Today and Tomorrow—L. L. Otto, professor, Michigan State University.

Texas Gulf Coast—Jan. 8

Schlumberger Well Surveying Corp. Dinner 6:00 p.m., meeting 7:00 p.m. Inspection trip through shops and plants of Schlumberger Well Surveying Corp., Houston, Texas.

Twin City—Jan. 13

Curtis Hotel. Dinner 6:30 p.m., meeting 8:00 p.m. Spectrographic Analysis of Lubricating Oils and Fuels—Ray McBrian, engineer of standards and research, Denver & Rio Grande R. R., Denver, Colo.

Western Michigan—Jan. 19

Bill Stern's Steak House, Muskegon. Dinner 7:00 p.m., meeting 8:00 p.m. To be announced—A. T. Colwell, vice-president, Thompson Products, Cleveland, Ohio.

Williamsport—Jan. 11

Moose Club, Williamsport. Dinner 7:00 p.m., meeting 8:00 p.m. Atomic Energy in Industry—L. M. Loeb, engineer, Knolls Atomic Power Laboratory, Schenectady, N. Y. This is a joint meeting with American Society of Tool Engineers.

This is not a complete list of all Section Meetings. It includes only those meetings for which we have received sufficient advance notice to permit listing.

TECHNICAL COMMITTEE *Progress*

Warning Lights, Signals Are Being Standardized by S-7

COMPLEXITIES of the modern cockpit, control center for all the complicated systems and mechanisms built into high-speed transports, place a severe load upon the crew to monitor continually and to operate correctly the many indicators, gages, controls, and switches. To make continual visual monitoring unnecessary, to assist the crew in ascertaining that the correct function has been accomplished when a control is actuated, and to give the quickest possible warning in case of fire or malfunctioning of any system or unit, it has been the practice to use warning lights and audible signals. Industry usage of colored lights and various types of audible signals is not uniform, although there is considerable similarity in many respects. In recognition of the need for standardization of function in the cockpit, S-7 the Committee on Cockpit Standardization—appointed a subcommittee to develop the standard for these lights and signals.

The first draft of the subcomittee has been presented to Committee S-7 for consideration and will probably complete amendment and approval at the next regular meeting of the committee.

According to part of the proposal, an aircraft cockpit signal system may consist of all or part of the following:

1. Warning lights. Lights provided to warn the crew of the imminence or existence of dangerous malfunctioning of aircraft or equipment, unsafe operating configuration or condition, which requires immediate protective or corrective action by the operating crew.

2. Advisory lights. Lights provided to indicate safe or normal configuration or conditions, performance or operation of essential equipment, attracting attention for routine purposes and miscellaneous functions.

3. Warning bell. A bell that operates automatically in conjunction with a warning light to indicate the existence of fire.

4. Warning horn. A horn that operates automatically to indicate an unsafe operating configuration.

One of the problems involved in the use of warning lights in the cockpit is that a light bright enough to be noticeable in bright sunlight is blinding to the pilots in a dark cockpit at night. If a dimming control is provided, there is the possible hazard that the light will not be turned up bright so as to be visible during the next daylight operation. (The operators have long made checking the warning lights—to see that they are properly adjusted for day or night—a part of the preflight check procedure.) Since it is sometimes impossible to locate all warning lights within the peripheral view of the crew members, the proposal includes master warning lights to be in the direct vision of at least one crew member. The proposal also specifies a list of 11 applications that must be protected by red warning lights and indicates whether the red light is to be steady or flashing and whether or not it is to be augmented by a bell. Similar recommendations are included for amber, green, and blue advisory lights.

Reliability Important

Since reliability is vitally important, master warning signal lights are to be of the dual-lamp type so that failure of a lamp filament will not result in an inoperative condition of the signal. Advisory signal lights may be of the single-lamp type, with a provision for testing, if the single lamp is used for essential indications.

C. M. Christenson of United is chairman of this subcommittee. Other members are: M. G. Beard of American, Scott Flower of Pan American, J. B. Fornasero of Boeing, O. R. Haueter of Continental, W. J. Martin of Consolidated Vultee, H. G. Portman of ALPA, and O. E. Tibbs of Glenn L. Martin.

At the request of the Air Transport Association, S-7 has also formed a group to consider the functionalization of electronic controls, such as the omnirange and heading selectors. F. E. Davis of Eastern is chairman of this subcommittee, with F. Addison of Delta, R. J. Baker of Trans-Canada, R. Blade of Pan American, G. H. Brink of American, M. B. Cahill of Northwest, C. M. Christenson of United, J. B. LeClaire of Trans World, H. G. Portman of ALPA, and Frank White of ATA-ANTC serving with him.

Because this problem is of a very

C. M. Christenson, United Air Lines, is chairman of the S-7 subcommittee on cockpit signal lights and audible signals

F. E. Davis, Eastern Air Lines, is chairman of the S-7 subcommittee on radio functionalization of electronic instruments and controls

specialized nature, each subcommittee member is being asked to bring along to subcommittee meetings his own company communications expert.

In addition to developing new standards, S-7 is also constantly engaged in revising standards already developed, in the light of new knowledge and developments.

For instance, the committee has been considering the necessity for adding a deviation to the rule in ARP 268 "Location and Actuation of Cockpit Controls for Commercial Transport-Type Aircraft" that switches and levers operate up for "on" and down for "off." The request for the deviation has been made because congestion in the cockpit is making it necessary to move radio panel units to an overhead location. Unforutnately, the switches on standard radio units would then operate in a direction opposite to that called for in ARP 268. For the moment the committee has decided to make no change, in the hope that further study of the matter will lead to a satisfactory compromise in the near future.

Suggest Shipping Wraps Based on Package Weight

WEIGHT of the contents is what counts when it comes to choosing the shipping wraps for fragile aircraft electrical equipment. In general, the lighter the item, the more packaging protection it needs. Why? Because packages that can be lifted shoulder high by handlers will suffer more shock if dropped than heavier ones that can only be lifted waist high. And dropping—not in-transit shock—is the thing that causes most of the major shipping damage to aircraft equipment.

That's one of the things brought out by the subcommittee on service conditions of SAE Committee S-8, Aircraft Equipment Shock and Vibration Isolation.

A study made by the subcommittee of shock encountered in the three major forms of transportation (truck, rail, and plane) led to this report. For it was found that acceleration rates varied from 0.5 to only 2.3 g. Thus, by a process of elimination, major damage suffered must be due to physical handling.

With this in mind, the subcommittee suggested that consideration be given to packaging equipment according to its weight. In support of its recommendation, the subcommittee noted that the British are presently using a system similar to this.

New Chairman and 5 New Members Named to '54 SAE Technical Board

WILLIAM M. WALWORTH has been named chairman of the SAE Technical Board for 1954. He is vice-president in charge of engineering for Reo Motors, Inc.

Walworth succeeds Earle MacPherson whose term as chairman of the Board expired at the end of 1953.

Five new board members were also appointed by SAE President-Elect William Littlewood to terms expiring at the end of the 1956 administrative year. They are B. B. Bachman, O. A. Brouer, F. W. Fink, W. C. Lawrence, and Harold Nutt.

Bachman is vice-president in charge of engineering for the Autocar Division of the White Motor Co. Brouer is head of Swift & Co.'s general automotive division. Fink is chief engineer of Consolidated Vultee. Lawrence is director of engineering for American Airlines. Nutt is assistant general manager as well as director of engineering for Borg & Beck.

Board members who will continue in office are P. C. Ackerman, D. P. Barnard, H. W. Browall, G. E. Burks, C. A. Chayne, H. E. Churchill, E. G. Haven, E. S. MacPherson, A. F. Meyer, Jr., C. E. Mines, F. N. Piasecki, and B. G. Van Zee.

Members whose terms will expire at the end of the 1953 administrative year are R. D. Kelly, R. P. Lewis, W. G. Lundquist, M. E. Nuttila, and E. W. Tanquary.

Chairman

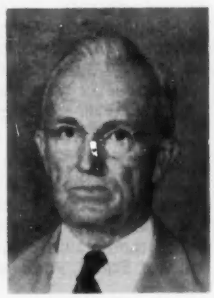
W. M. Walworth

B. B. Bachman

O. A. Brouer

F. W. Fink

W. C. Lawrence



Harold Nutt

Technishorts . . .

HIGH-SPEED aircraft of tomorrow won't tolerate even minor errors or malfunctions in autopilots and flight director instruments. This was brought out at a recent meeting of the SAE Aircraft Instruments Committee. Any wild signal may even disintegrate a high-speed airplane.

The problem is more critical under cruise conditions than in approach. On an approach, the pilot's attention is directly focussed on control movement changes. Under cruise, it may take some time before he becomes aware of an abnormal movement.

The aircraft industry now is working on safeguards to prevent such troubles and the Committee will eventually incorporate such measures in its specifications.

TECHNICAL AID: A German Non-Cutting Metal Forming Study Group met informally last October in Detroit with a number of SAE members to learn about American production techniques. The session was arranged by SAE at the request of the Mutual Security Agency. V. A. Crosby, of Climax Molybdenum acted as chairman. The Germans asked questions on such subjects as tests and procedures in receiving sheet steel, wire, and double extrusion bolts; induction heating; extrusion; tungsten carbide inserts; and treatment and preparation of metal and plastic dies.

These reports have been approved recently by the SAE Technical Board . . .

BRAKE BLOCK CHAMFER—An SAE Standard for Brake Block Chamfer. As noted in the standard, this chamfer is to be formed by cutting off the ends of a block which are parallel to the length centerline. The cuts, themselves, are to intersect the radial ends of the block at the centerline of thickness. Where the arc length of a block is more than 70 deg, the standard states that the ends shall be cut off parallel to a radius 35 deg from the ends, this line to intersect the radial ends at a point one-half the thickness of the block.

ROTATING AIR CYLINDERS AND ADAPTERS—As one of the sponsors of ASA Sectional Committee B-5, the Society has approved the committee's recommendation that the American Standard for Rotating Air Cylinders and Adapters be reaffirmed. B-5's activities cover standardization of small tools and machine tool elements.

KNURLING—An American Standard on Knurling. This standard covers knurling tools with standardized diametral pitches and includes dimensional relations with stock in the production of straight, diagonal, and diamond knurling on cylindrical surfaces. It is aimed at improving the uniformity and appearance of knurling, eliminating costly trial and error methods, reducing the failure of knurling tools and decreasing the number of tools required.

GRINDING WHEEL MARKINGS—American Standards on "Markings for Grinding Wheels and Other Bonded Abrasives" and "Life Tests of Single-Point Tools Made of Materials Other Than Sintered Carbide." These ASA standards have been reaffirmed on the recommendation of ASA Sectional Committee B-5 on Standardization of Small Tools and Machine Tool Elements.

Basic Commercial

THE need for up-to-date, clear-cut, basic engineering definitions of the various types of commercial motor vehicles has been met! The SAE Commercial Motor Vehicle Nomenclature Committee's recently revised SAE standard for Commercial Vehicle Nomenclature fills the bill. (It is now the SAE Standard for Commercial **Motor** Vehicle Nomenclature.)

The new standard, which will appear in the 1954 SAE Handbook, puts the accent on supplying this much-needed basic engineering information in a completely straightforward manner. In sequence, it defines first a vehicle, next a motor vehicle and all its variants, then commercial vehicle as distinguished from private, emergency, and other motor vehicles, and finally all types of commercial vehicles. In the process, the standard also points out many types of motor vehicles that cannot properly be classified as **commercial** motor vehicles.

Adhering to the belief that a picture is worth 10,000 words, the committee decided to include illustrations of common commercial motor vehicle combinations in the standard. (See adjoining box.)

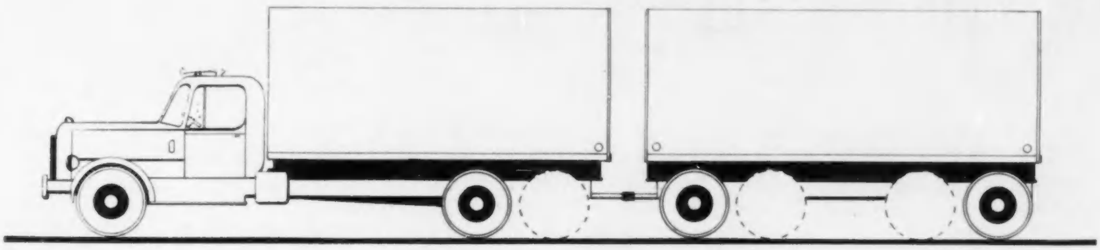
These simple, short definitions are designed to provide a solid engineering base on which more detailed definitions of specific vehicles can be built, if desired. Among other things, they're expected to be helpful guides to licensing, legislative, and contractural authorities.

The SAE Commercial Motor Vehicle Nomenclature Committee undertook this project at the request of the Automobile Manufacturers Association.

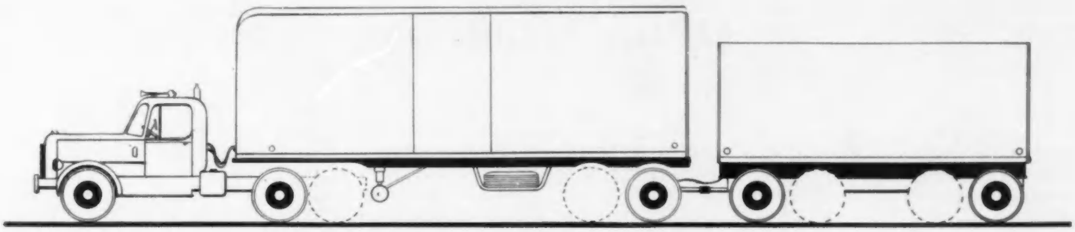
Serving on the committee were: F. K. Glynn, American Telephone and Telegraph, Chairman; W. L. Cross, Jr., Department of Motor Vehicles, Conn.; M. W. English, National Highway Users Conference; J. A. Harvey, Pittsburgh Railways; M. C. Horine, Mack; C. P. Hottle, Pacific Motor Trucking; J. B. Hulse, Truck-Trailer Manufacturers Association; Henry Jennings, Fleet Owner; L. C. Kibbee, American Trucking Associations; A. G. Laas, Studebaker; E. P. Lamb, Chrysler; F. B. Lautzenhiser, International Harvester; G. W. Laurie, Atlantic Refining; W. T. Menewisch, GMC Truck & Coach Div.; T. L. Preble, Tide Water Associated Oil; C. B. Rawson, Commercial Car Journal; K. M. Richards, Automobile Manufacturers Association; F. E. Sandberg, Ford; J. W. Sinclair, Union Oil; J. L. S. Snead, Jr., Consolidated Freightways; G. M. Sprowls, Goodyear; and Hoy Stevens, Bureau of Public Roads.

Motor Vehicles Get Simple Engineering Definitions

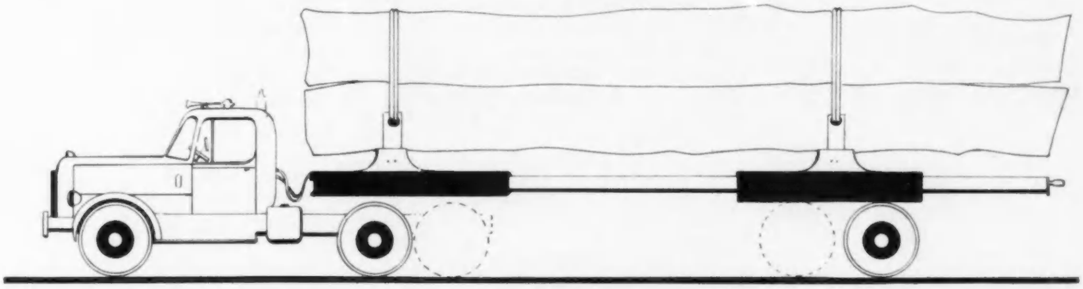
SEEING adds a lot to reading, believed the SAE Commercial Motor Vehicle Nomenclature Committee. So it included these illustrations of common commercial motor vehicle combinations in the new SAE Standard for Commercial Motor Vehicle Nomenclature.



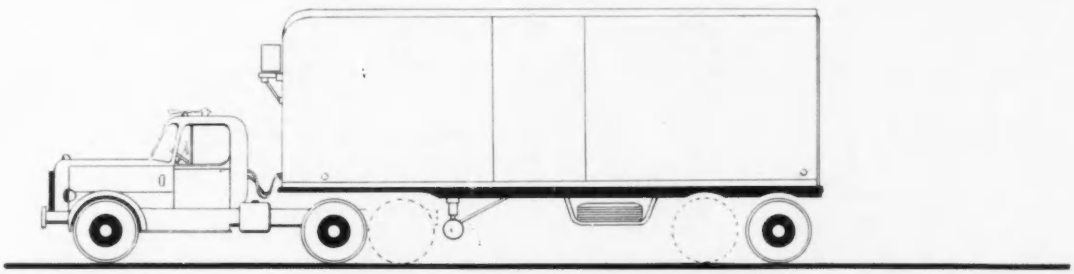
Truck Full Trailer



Tractor Semitrailer and Full Trailer



Pole Trailer



Tractor Semitrailer

CRC V/L Apparatus Helps Evaluate Fuels

A NEW CRC report tells what to use —and how to use it—to determine the vapor-forming tendencies of fuels at low vapor-to-liquid (V/L) ratios.

The apparatus described in this report was originally intended to fulfill a need of the aviation industry. (Aircraft were experiencing vapor-lock difficulties during World War II.) But it also is satisfactory for evaluating any hydrocarbon mixture having vapor-pressure characteristics similar to aviation or motor gasolines.

Specifically, this CRC V/L apparatus permits determining the following characteristics of such fuels:

1. V/L temperature relationships
2. Air solubility
3. Vapor pressure

Whether the information in this report is applicable to current gas turbine fuels and fuel systems has not yet been determined. This decision must await the completion of other projects now in progress covering the volatility of gas turbine fuels.

This document, CRC 269, entitled, "Evaluation of the CRC V/L Apparatus," was prepared by the Group on Design of V/L Apparatus of the CFR Aviation Fuels Division. It is available from the SAE Special Publications Department. Price: $1.50 to members, $3.00 to nonmembers.

CRC Reports Effect Of Heat on Stored Gas

AT the request of the Armed Forces, the CRC made a study of the gum stability of gasoline stored during long periods under various climatic conditions. The results of this study are now available in a report entitled, "Temperature of Stored Gasoline, 1943-1945 Desert Storage Tests on Motor and Aviation Gasoline."

The data included in this document were obtained from a two-phase program, consisting of:

1. A pre-storage temperature survey
2. A desert storage temperature study

The pre-storage temperature survey involved the assembling of available worldwide air-temperature data and available data on the temperature of gasoline in storage. From these data, an estimate was made of what might be expected in the way of air and gasoline temperatures.

The second phase of the program consisted of desert storage tests, conducted to establish an experimental basis for more reliable prediction of storage stability.

Out of these tests came the information which this report includes, namely:

- The relation between air temperature and the temperature of gasoline stored under various conditions in 5 and 55-gal drums.
- The correlation between the effect of high temperature outdoor storage and laboratory storage at a suitably chosen constant temperature.

This report, CRC-270, was prepared by the groups working on Gasoline Additives Projects of the Motor Fuels and Aviation Fuels Divisions of CRC. It is available from the SAE Special Publications Department. Price: $2 to members, $4 to nonmembers.

What's Coming in SAE Aero Materials Specs

NINETEEN proposed new and revised specifications are being circulated to industry for review and comment by the SAE Aeronautical Materials Specifications Division. Copies of these specifications are available from the SAE Aeronautical Department.

Thirteen new and revised specifications have been approved recently by the SAE Technical Board.

The proposed specifications are:

- AMS 4018—Aluminum Alloy Sheet and Plate, 3.5Mg-0.25Cr (54S-0);
- AMS 4019—Aluminum Alloy Sheet and Plate, 3.5Mg-0.25Cr (54S-H32);
- AMS 4286—Aluminum Alloy Castings, Permanent Mold, 7Si-0.3Mg (356-T51) Stress Relieved;
- AMS 5521B—Steel Sheet and Strip, Corrosion and Heat Resistant, 25Cr 20Ni (SAE 30310) (Deep Drawing and Spinning);
- AMS 5639A—Steel, Corrosion Resistant, 19Cr-9Ni (SAE 30304);
- AMS 5640F—Steel, Corrosion Resistant, 18Cr-9Ni (SAE 30303F) Free Machining;
- AMS 5642C—Steel, Corrosion and Heat Resistant, 18Cr-11Ni-(Cb+Ta) Free Machining;
- AMS 5645G—Steel, Corrosion and Heat Resistant, 18Cr-10Ni-Ti (SAE 30321);
- AMS 5646D—Steel, Corrosion and Heat Resistant, 18Cr-11Ni-(Cb+Ta) (SAE 30347);
- AMS 5648C—Steel, Corrosion Resistant, 18Cr-13Ni-2.3Mo (SAE 30316);
- AMS 5651C—Steel, Corrosion and Heat Resistant, 25Cr-20Ni (SAE 30310);
- AMS 5768B—Alloy, Corrosion and Heat Resistant, Iron Base-20Cr-20Ni 20Co-3Mo-2W-1(Cb+Ta), Solution and Precipitation Treated;
- AMS 5572B—Steel Tubing, Seamless, Corrosion and Heat Resistant 25Cr-20Ni (SAE 30310);
- AMS 5577A—Steel Tubing, Welded, Corrosion and Heat Resistant, 25Cr-20Ni (SAE 30310);
- AMS 7488—Rings, Flash Welded, Aluminum and Aluminum Alloys;
- AMS 7490B—Rings, Flash Welded, Austenitic Corrosion and Heat Resistant Steels and Alloys;
- AMS 7493B—Rings, Flash Welded, Non-Austenitic Corrosion Resistant Steels;
- AMS 7496B—Rings, Flash Welded, Carbon and Low Alloy Steels;
- AMS 7498—Rings, Flash Welded, Titanium and Titanium Alloys.

The approved specifications are:

- AMS 2261B—Tolerances and AMS 5120D-Steel Strip;
- AMS 3274A—Synthetic Rubber Sheet, Nylon Fabric Reinforced;
- AMS 3285A—Felt, Back Check, White, 100% Wool;
- AMS 3286A—Felt, Firm Pad, White, 100% Wool;
- AMS 3624A—Plastic Moldings and Extrusions;
- AMS 5538—Steel Sheet and Strip, Corrosion and Heat Resistant;
- AMS 5539—Steel Sheet and Strip, Corrosion and Heat Resistant;
- AMS 5542D—Alloy Sheet, Corrosion and Heat Resistant;
- AMS 5667D—Alloy, Corrosion and Heat Resistant;
- AMS 5668D—Alloy, Corrosion and Heat Resistant;
- AMS 6351—Steel, Sheet and Strip;
- AMS 7245B—Inserts, Thread Form, Corrosion Resistant Steel;
- AMS 7247B—Inserts, Thread Form, Phosphor Bronze.

CRC Reports on Burned Valve Epidemic

WHAT a CRC group found when it investigated the valve burning epidemic of 1945-46 is revealed in the recently released CRC Report, "Valve Burning."

Besides tracing the geographical extent of this winter month epidemic, the report outlines possible reasons why it may have happened.

Prepared by the Valve Burning Panel of the Engine Varnish and Sludge Group in the Motor Fuels Division, this report, CRC-272, is available from the SAE Special Publications Department. Price: 50¢ to members, $1.00 to nonmembers.

SAE Student News

Chrysler Institute

On November 12, the Student Branch began activities for the year by having Professor E. T. Vincent, of the University of Michigan, speak about gas turbines and their application to the automotive field.

Vincent is known both in the U. S. and abroad for his work in mechanical engineering, especially for his work dealing with reciprocating engines. He is chairman of the mechanical engineering department at the University of Michigan.

Vincent also gave a background of the operating characteristics of the gas turbine, and included the design methods by which some undesirable characteristics could be partially, if not wholly, overcome.

Some of the advantages of the gas turbine listed by Vincent were: smooth operation, no octane problem in fuels, simple lubrication system, no ignition system except for starting, maximum torque at stall, no clutch, and light weight.

Disadvantages were: large ducts required, high fuel consumption, bearing problems resulting from high speed operation.

Student officers for the year are: Calvin Miller, chairman; Fred Hagen, vice-chairman; William Smyth, secretary; James Bair, treasurer.

University of Cincinnati

"A Comparison of the Internal Combustion Engine to the Gas Turbine" was presented by Richard Wysong at the December 2 meeting. Wysong was an instructor in the U. S. Air Force. He is now a student at the University of Cincinnati and co-ops at General Electric Co.'s Gas Turbine Division.

A Walt Disney film about jet propulsion and an Air Force film about flight testing an F-86 were shown.

University of Washington

Martin Headman, project engineer, Western Gear Works, Seattle, spoke about the two famous unlimited Hydroplanes—Slo-Mo-Shun IV and Slo-Mo-Shun V. These two power boats were winners of several races, among them The Gold Cup Race in Detroit, August, '51, and The Harmsworth Race, September, '50.

Headman discussed general maintenance problems of the boats and their special gearing problems. (Western Gear manufactured the gear-box for the two boats.)

Bob Norrie, chairman of the Northwest Section, was at the meeting along with Ed Rentz, Manager of SAE's Western Branch Office.

Aeronautical University

Members of the SAE Student Branch at the Aeronautical University, Chicago, gained first-hand information about the production of die castings. The students were guests of the Chicago plant of the Aluminum Company of America, December 4.

They were welcomed by E. S. Goff, assistant employment manager. Goff gave a brief sketch of the company and then members listened to F. D. Sanborn, chief engineer. Sanborn spoke about the relationship between aluminum die casting and the aeronautical engineering field. Then, wearing safety glasses, the students toured the plant.

The Pennsylvania State College

J. N. Maybry of Reaction Motors, Rahway, N. J., presented his paper, "Rocket Engines—Their Present and Future Use" at the November 4 meeting. Maybry gave a brief resume of the early attempts of the Chinese in utilizing the reaction motor principle and traced the progress of rocket and jet ideas to the present time.

Of particular interest was his statement that rocket and space travel were ideas first conceived in a period from 1850 to 1900. Maybry then outlined basic principles of reaction motors.

"High Speed Flight," a film, was shown after Maybry's talk. It dealt with jet aircraft research and testing at Edward's Air Force Base, Calif.

University of Miami

The sports car was the theme of SAE's Student Club meeting held Nov. 4. The program was presented by Waco Motors, Inc., dealers and importers of European sports cars, and included a display of the latest models.

Students enjoyed a movie of the construction, design and testing phases of the M. G. and Morris. They also saw films of road races—the Sebring and Palm Beach, as well as one of the Bonneville Salt Flats Race. Robert Gagen, road race and sports car driver, was narrator.

E. Stone, sales manager for Waco, spoke to members on the definition of a sports car.

California State Polytechnic College

At the last meeting of the Student Branch, Chester Kodera of Sperry Gyroscope spoke about the future of the mechanical engineer as connected with electronics. Kodera has been with Sperry for thirteen years.

He said that the mechanical engineer is here to stay—even with new advances in the electronics field.

"Electronics has only been scratched on the surface, and it is so complicated that the mechanical engineers are needed. I cannot stress the importance that the mechanical engineer plays in these times. As a matter of fact, this falls true for all engineers whether mechanical, electrical, chemical, or any of the various other types of engineers. But the mechanical engineer is the keystone of modern industry."

Chester Kodera of Sperry Gyroscope (left) is shown explaining the future of a mechanical engineer with Sperry to Frank E. Tippets (center) and to Cal-Poly Chairman Stanley D. Adkins

About SAE


Troendly Gamble

HARRY P. TROENDLY has been elected president of the Spring Div., Borg-Warner Corp., Chicago. He was previously vice-president and general manager. Troendly succeeds **D. EDWIN GAMBLE,** who has retired.

ALBERT R. JACOBS is now staff management engineer for the Lycoming-Spencer Division, AVCO Mfg. Corp., in Williamsport, Pa. Jacobs was a project coordinator for the Kaiser-Frazer Corp., Detroit.

MARTIN J. CASERIO has been promoted to chief engineer of automotive products for AC Spark Plug Div., GMC, Flint, Mich.

HARRY P. DOBROW, formerly with the Hudson Motor Car Co., has joined the Alloy Engineering and Casting Co. of Champaign, Ill., as assistant chief engineer. His duties will include supervision of the company's armed forces research and development program.

BYRON T. VIRTUE, formerly chief engineer of The Torrington Co.'s Bearings Div., has been promoted to general sales manager.

C. J. REESE, president and general manager of Continental Motors Corp., has been elected president of the Automotive Parts Manufacturers Association for 1954.


Reese Appel

LESLIE H. APPEL has retired from his position as research engineer for the Pacific Electric Railway, Los Angeles, after 41 years of service. After a brief rest he intends to work on a new safety publication. Appel recently donated his 25-yr collection of SAE Journals to the Loyola University Library in Los Angeles.

HUBERT C. SMITH has been named vice-president in charge of metallurgical control for Great Lakes Steel Corp., Ecorse, Mich. Associated with Great Lakes Steel since 1936, Smith has been an assistant vice-president since 1949. He is assistant vice-chairman of the SAE Detroit Section's Engineering Materials Activity, and presided as chairman for the Activity session during the 1953 Annual Meeting.


Smith Boyd

T. A. ("TAB") BOYD has retired from General Motors Research Laboratories. There he formerly headed the fuel department and more recently had served as a research consultant.

Boyd, together with Charles F. Kettering and the late Thomas Midgley, Jr., discovered tetraethyl lead's value as an antiknock compound.

Boyd received SAE's Horning Memorial Award in 1950. Ohio State University has honored him with the Lamme Medal for meritorious achievement in engineering and with a professional degree in chemical engineering.

CURTIS C. STEWART, publisher of "The Chicago Shipper," an independent monthly news magazine written for the shipper, industrial traffic manager, and motor carrier executive, has announced that effective with the January 1954 issue, the publication will be known as the "National Hi-Way Shipper." The publication has a 12,000 circulation and is nation-wide in its scope.

EDWARD GAYLE BULPITT, formerly junior technical analyst in the research laboratory of Cummins Engine Co., Inc., Columbus, Indiana, has accepted a position as project engineer in the turbojet development group of the Allison Div., GMC, Indianapolis.

ROY W. VORHEES, JR., has become supervisor of product planning and estimating for the Dodge Division of Chrysler Corp. Vorhees was a factory manager at the Plymouth Division of Chrysler.

HARRY H. BITTNER has become manager of the garage and service station, Navy Exchange, San Francisco. Bittner was automotive fleet supervisor for Golden State Co., Ltd. in San Francisco.

H. W. SMITH is now a consultant in the Engine Division of the Caterpillar Tractor Co., Peoria, Ill. He was manager of the industrial sales section of Caterpillar.


Smith Martin

GLENN L. MARTIN delivered the seventeenth Wright Brothers Lecture for the Institute of the Aeronautical Sciences, December 17, in Washington, D. C. Martin is the founder and a director of The Glenn L. Martin Co. **DR. JEROME C. HUNSAKER,** professor emeritus of aeronautical engineering, MIT, served as lecture chairman. He was introduced by **CHARLES J. McCARTHY,** IAS president and vice-president of United Aircraft Corp.

Members . . .

HELMUTH G. BRAENDEL, director of engineering and production of Wilkening Mfg. Co., Philadelphia, was one of the speakers at the Fourth Annual Diesel Powerplant Conference sponsored by the College of Engineering, University of Missouri, Columbia, Mo., November 16 and 17. His subject was, "Piston Rings as Applied to Diesel Engines."

J. S. PARKER, formerly with the Aircraft Gas Turbine Division, GE, Cincinnati, is now general manager of the small aircraft engine department for Aircraft Gas Turbine, GE, in Boston.

JOHN A. MATOUSEK has been named vice-president and general manager of the Baker-Raulang Co., Cleveland. He will be responsible for all activities in the Baker-Raulang operation, reporting to the chairman of the board. He was previously vice-president of manufacturing.

Matousek

Webb

JERVIS C. WEBB, executive vice-president and general manager of Jervis B. Webb Co., Detroit, has been elected to the vice-presidency of the Conveyor Equipment Manufacturers Association.

EDWIN P. WALSH has joined Experiment, Inc., Richmond, Va., as head of the mechanical design department. He was with the Westinghouse Electric Corp., Aviation Gas Turbine Div., as an advisory engineer.

JAMES D. MOONEY has formed his own organization of management consultants, J. D. Mooney Associates, New York. He was formerly vice-president of GMC in charge of Overseas Operations, and a director of GMC, New York. Later he was president and chairman of the board of Willys-Overland Motors, Inc., Toledo. He is author of "Principles of Organization," published by Harper Bros.

Mooney

Acheson

HOWARD A. ACHESON has been relected president and member of the board of directors, Acheson Industries, Inc. Acheson Industries includes Acheson Colloids Ltd., London, Acheson Dispersed Pigments Co., Philadelphia, and Gredag, Inc., Niagara Falls, N. Y.

HARVEY J. LANDER is now at the Massachusetts Institute of Technology as a research assistant in metallurgy. He was previously liaison engineer at the Hamilton Standard Division, United Aircraft Corp., Bradley Field, Windsor Locks, Conn.

ELTON F. NICHOLS is now a sales engineer with The Anderson Co., Gary, Ind. He was previously chief engineer for Sprague Devices, Inc., Michigan City, Ind.

GEORGE V. CRAIGHEAD has become district sales manager for the Aluminum Co. of America at Buffalo. Craighead was formerly assistant district sales manager for the company at Detroit.

WILLIAM S. COWELL has become vice-president and general manager of Wheel & Rim Co. of Canada, Ltd., Toronto. He was general sales manager of Atlas Asbestos Co., Ltd., Montreal.

Cowell

Kramer

HAROLD K. KRAMER has been appointed purchasing agent for the Wagner Electric Corp., St. Louis, Mo. He was previously assistant to the chief automotive engineer at Wagner and has been with the company since 1933.

STEPHEN BIXBY, previously chief mechanical engineer for the Minneapolis-Honeywell Regulator Co., has become operations manager for the company at the Appliance Controls Division in Los Angeles.

WALTER F. McCOSKEY is with the Packard Motor Car Co., Detroit, as a project engineer. He was a mechanical engineer in the U. S. Army stationed at Camp Dietrick, Maryland.

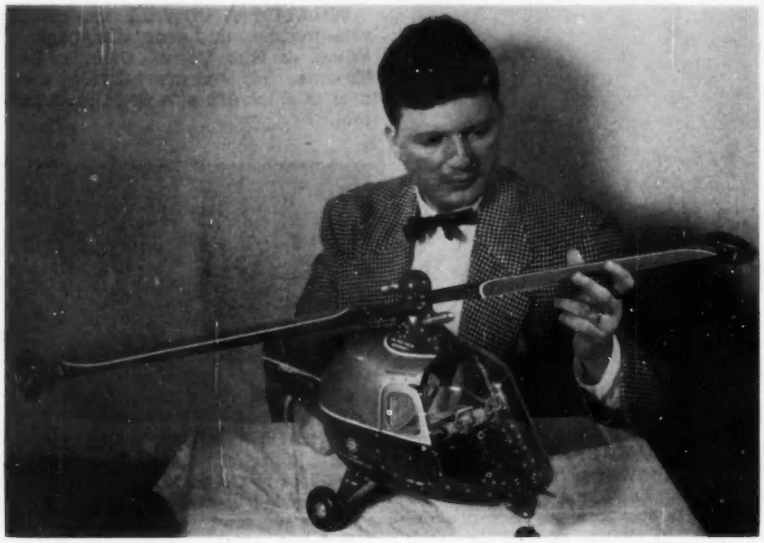
CHARLES W. HOWARD is now with the Goodyear Tire and Rubber Co., Inc., Detroit. Howard is a manufacturers sales representative.

L. L. COLBERT, president of Chrysler Corp., Detroit, was speaker at the Detroit Round Table of the National Conference of Christians and Jews at the Masonic Temple in Detroit, November 19.

Colbert

Rockwell

COL. WILLARD F. ROCKWELL, chairman of Rockwell Mfg. Co., has been elected to the board of directors of American Locomotive Co. Rockwell is also chairman of the Rockwell Spring and Axle Co., formed last September by a merger of Timken-Detroit Axle Co. of Detroit and Standard Steel Spring Co. of Coraopolis, Pa.



NICK G. STASINOS has formed his own company which manufactures training aids for industry and schools. It is the California Visual Aids Co., 6214 West Manchester Avenue, Los Angeles. Stasinos was formerly with Hughes Aircraft Co., Culver City, Calif., in the preliminary design department working on interceptor fire control systems.

JAMES M. LEAKE, president of The Leake Stamping Co., Monroe, Mich., has been elected vice-president of the Pressed Metal Institute (the national trade association for the metal stamping industry).

GEORGE N. SCHRAMM has been elected a director of the Pressed Metal Institute. Schramm is with the Market Development Division, sales department, U. S. Steel Co., Pittsburgh.

ROBERT H. FRITZGES, previously general engineer for Mack Mfg. Corp. in Allentown, Pa., is now sales engineer for Hydramotive, Inc., Cleveland.

LaVERNE MORGAN has joined the staff of the Edward R. Bacon Co., San Francisco, as general superintendent of the shops and warehouse in Oakland, Calif. He was formerly director of maintenance, F. N. Rumbley Co., Inc., Fresno, Calif.

Changes at Hercules Motors

Keplinger

JOHN C. KEPLINGER has been named president of Hercules Motors Corp., Canton, Ohio, manufacturers of gasoline and diesel engines. Keplinger was previously executive vice-president of the company and has been with Hercules since 1926.

CHARLES BALOUGH is the new chairman of the board of directors. He was one of the organizers of Hercules Motor Mfg. Co., founded in 1915. He has been a director of Hercules Motors since 1923 and president since 1929.

GEORGE W. LaSALLE has been named a vice-president and **DR. E. A. V. HORIAK** is now chief engineer. LaSalle was chief engineer of the Gasoline Division and Horiak was chief engineer of the Diesel Division.

ROBERT CASS, president of SAE and assistant to the president of White Motor Co., Cleveland, spoke at a luncheon meeting of The Automotive Transport Association of Ontario, November 23. Cass' subject was, "Factors in Future Transport Operations."

RALPH S. DAMON, president of Trans World Airlines, has been named to the National Advisory Committee for Aeronautics by President Eisenhower. Damon will serve for five years without compensation.

SAE members on the Policy Committee of the National Council of Private Motor Truck Owners, Inc., are: **O. A. BROUER,** Swift and Co.; **G. W. LAURIE,** The Atlantic Refining Co.; **H. O. MATHEWS,** Armour and Co.; **HENRY ROWOLD,** Mack Motor Truck Corp. The Policy Committee is composed of chairmen of all standing committees. Members met last month to formulate recommendations for presentation at the Council's Fifteenth Annual Meeting, at the Conrad Hilton Hotel, Chicago, Jan. 28–29.

LEONARD W. PEOPLES, previously design and detail engineer with Page & Page Co., Portland, Oregon, is now employed by Transitier Truck Co., Portland, as a project engineer.

RAYMOND P. POYNER is now in the U. S. Navy. He is a lieutenant, junior grade. Poyner was formerly a research engineer at the Caterpillar Tractor Co.

W. H. FAIN, formerly a sales representative for the Houston Engine & Pump Co., Houston, Texas, is now superintendent of equipment at the Galveston Transit Co.

CALVIN T. THOMAS was guest speaker at the November 17 dinner-meeting of the Los Angeles Desk and Derrick Club. Thomas is manager of automotive equipment, marketing department, for the General Petroleum Corp. He spoke on "Automotive Transportation in Oil."

JOHN M. CLEM is now district manager of the Air-Mazo Corp. He is in charge of the Chicago office. His district includes Indiana, Illinois, Wisconsin, Minnesota, Iowa, Nebraska, Kansas, and Missouri. He was previously a factory representative in New York for Air-Mazo.

CHARLES D. McCALL has been appointed to the new position of manager of automotive engineering within the engineering department of the New Departure Division, GMC. McCall was previously New Departure's general sales manager. In his new duties, he will report to the division's chief engineer, **FREDERICK J. GARBARINO.**

LLOYD DOUGLAS SMITH has joined the Temco Aircraft Corp., Dallas, as a design engineer. Smith was formerly senior designer with Goodyear Aircraft Corp., Litchfield Park, Arizona.

ROBERT S. MARTIN has become branch manager of the Alban Tractor Co., Arlington, Va. Martin was formerly a district representative for Caterpillar Tractor Co., Peoria, Ill.

EDWARD G. GROSS, president of Coretti-Gross, Inc., Pelham Manor, N. Y., has been promoted to the rank of Major as a reserve officer in the U. S. Army Corps of Engineers.

ROBERT E. WILSON is now employed by Continental Aviation and Engineering Corp., Detroit. He is a development engineer. Wilson was formerly chief test engineer for National Presto Industries, Inc., Eau Claire, Wis.

ADM. EMORY S. LAND has resigned as president of the Air Transport Association. He was war-time head of the Maritime Commission and War Shipping Administration. Land has been president of the association for eight years.

A. SIDNEY HANSON has joined the Wright Aeronautical Corp. in the Field Engineering Division. Hanson has recently been acting chairman of the SAE Aeronautics Committee E-25, Engine & Propeller Standard Utility Parts, while the regular chairman has been ill.

Hanson

vanDyk

E. J. vanDYK, former sales engineer for the Detroit Diesel Engine Div., GMC, at Tulsa, Okla., has been transferred to the Detroit home office as a sales engineering consultant.

T. K. ROSSITER is with Ford Motor Co.'s service department, New York District, as service representative and instructor.

LT. COL. SIDNEY G. HARRIS, USAF, has graduated from the Logistics Course, Air Command & Staff School, Maxwell AFB, Alabama. He has been ordered to Hdqrs., FEALOGFOR, Far Eastern Air Force, APO 323 c/o Postmaster, San Francisco, Calif.

Chayne Says:

CHARLES A. CHAYNE, vice-president of General Motors Corp., at the Annual Meeting of the American Association of Motor Vehicle Administrators explained to AAMVA members how the automotive industry goes about improving vehicle safety. He also pointed out some of the tangible things that have resulted.

To begin with, Chayne noted, each vehicle company and equipment vendor assigns responsibility for safe performance of various vehicle components to qualified personnel.

On top of this, design features of these components are subject to continuous research to achieve better performance, greater durability, and increased safety.

Then, with the new design approved and production begun, parts are subjected to detailed inspection to insure high quality.

Finally, proving grounds come into the picture again. But this time for a different and unique role—to provide an engineering audit. The idea here, Chayne explained, is to determine how the product compares with what was expected from the preproduction engineering tests. Also, the vehicle is critically compared with both domestic and European counterparts.

To Chayne, this engineering audit and "dream cars" have played important roles in improving vehicle safety and durability. But so has the cooperative program between the automotive industry and highway officials, he added. It has permitted a highly competitive industry to continue developing new and better motor vehicles without unwarranted restrictions.

Out of this combined program, Chayne continued, are coming many things which make it easier for a driver to stay out of accidents. For example, wider windshields and rear windows, power brakes, power steering, and better acceleration for passing.

VINCENT D'AVERSA, president of A & D Diesel Service, Inc., Brooklyn, N. Y., has announced that A & D will be the sales and service representative on diesel fuel injection equipment for American Bosch Corp.

E. J. WICKENDEN, previously service representative for Canadian Car & Foundry Co., Ltd., Montreal, is now with the Provincial Transport Co., Montreal.

JOHN E. LAURANCE, formerly physical science administrator for the Office of Naval Research, Washington, D. C., is now an operations research engineer for the Military Operations Research Div., Lockheed Aircraft Corp., Burbank, Calif.

ROY KAMO is a research engineer at the Technology Center, Armour Research Foundation, Chicago. He was with North American Aviation, Los Angeles, as an aerodynamics engineer "A".

ROBERT M. WARD has joined the Ramsey Corp., St. Louis, Mo., as manager of the Manufacturing Division. He was manager of the U-Flex Division of Thompson Products, Inc. in Cleveland. Thompson is a subsidiary of the Ramsey Corp.

MARCEL CLARK has been promoted to district manager for Quebec and the Maritimes, Wix Accessories Corp., Ltd. Clark has been sales representative for the province of Quebec for the past six years. In his new position he will be responsible for planning the sales activities of his district.

Clark

Werner

LOUIS A. WERNER has joined the Soss Mfg. Co., Detroit, as director of research. He was formerly chief engineer, Palmer Bee Co., Detroit.

H. H. RHOADS, president of Hydro-Aire, Inc., announces that the Burbank aircraft accessories firm has purchased an additional ten acres in the vicinity of its main plant at 3000 Winona Ave., Burbank. According to Rhoads, the newly acquired property will be used to expand and consolidate the company's facilities in turbomachinery research and development, and in the production of aircraft fuel booster pumps.

Medallion Unveiled at Caterpillar

LOUIS B. NEUMILLER, (left) president of Caterpillar Tractor Co. and **H. S. EBERHARD,** executive vice-president, unveil a large medallion at Peoria, Ill. This medallion represents the theme for a commemorative program Caterpillar will conduct in 1954 to celebrate the 50th anniversary of the world's first practical track-type tractor. The Holt Manufacturing Co., one of Caterpillar's parent companies, successfully tested the first practical crawler on Nov. 24, 1904 in Stockton, Calif.

JOHN LYON COLLYER, president of B. F. Goodrich Co., has been cited as an example to American youth. "National Biographic," a publication distributed to high school students, appraised Collyer as an outstanding business leader whose vision and expert understanding of world affairs has been valuable to the nation.

I. F. RICHARDSON, Jr. has been appointed assistant general manager of the Kansas City Division of Bendix Aviation Corp. He was manager of aircraft equipment sales and service for the Bendix Products Div., South Bend, Ind.

E. M. KENNEDY is with General Motors Truck and Coach Division, Pontiac, Mich., as a senior designer. Kennedy was a product engineer for General Motors do Brazil, S. A.

CHARLES A. BARESCH has become project engineer for Davis Aircraft Products, New York. Baresch was chief engineer for Robinson Air Activated Conveyor Systems, New York.

ALPHONSE A. JACOBELLIS has joined Republic Aviation Corp., Farmingdale, N. Y. as a designer of hydraulic systems. He was an applications engineer for the Fulton-Sylphon Division of Robertshaw-Fulton Controls Co., Knoxville, Tenn.

PERRY FINA and his shop, Perry's Auto Repairs, were the center of interest in Esquire's "Carriage-Trade Shop," Dec. 4 issue. Fina is known for building cars that are "different."

JAMES B. EDWARDS is now with the Douglas Aircraft Co., Inc., Santa Monica, Calif., as a project engineer. He was previously chief engineer of Hiller Helicopters, Palo Alto, Calif.

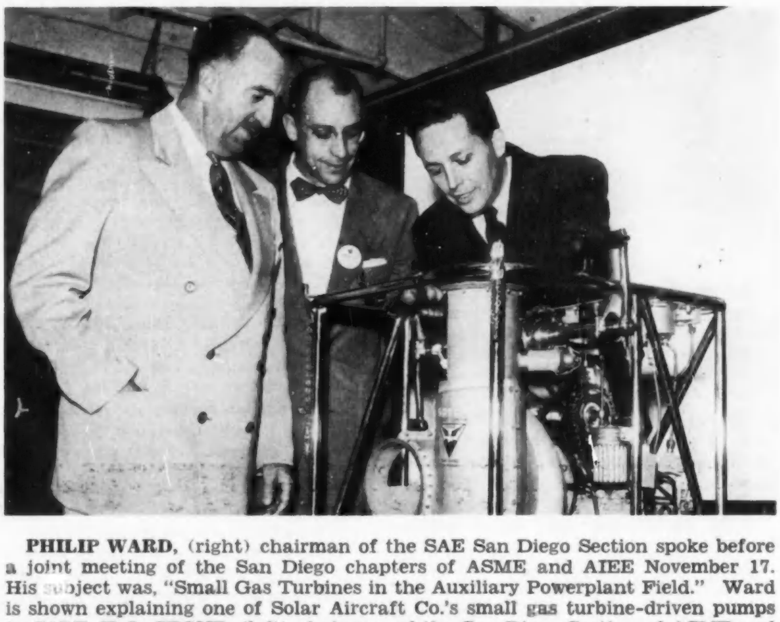
KENDALL D. TAYLOR, formerly supervisor of dynamometer tests at the Buick Motor Div., GMC, Flint, Mich., is now project engineer on motors at Buick.

ANDREW W. ZMUDA has moved from Buick Motor Div., GMC, where he was senior engineer, to Houdialle-Hershey Corp., Detroit, as senior design and development engineer.

G. PETER BLOM is now assistant branch manager of the Chicago office, Equipment Sales Division, of Raybestos-Manhattan, Inc. He was formerly a sales engineer.

JOHN J. WITMER, JR., is with Cutler-Hammer, Inc. as a sales engineer. Witmer was previously with Redmond Co., Inc., Owosso, Mich., as a sales engineer.

San Diego Chairman is Speaker



PHILIP WARD, (right) chairman of the SAE San Diego Section spoke before a joint meeting of the San Diego chapters of ASME and AIEE November 17. His subject was, "Small Gas Turbines in the Auxiliary Powerplant Field." Ward is shown explaining one of Solar Aircraft Co.'s small gas turbine-driven pumps to **CAPT. H. L. STONE,** (left) chairman of the San Diego Section of ASME and **I. E. McDOUGAL,** (center) chairman of the San Diego Section of AIEE.

Obituaries

MARION B. CRAWFORD

Marion B. Crawford, staff engineer, United Air Lines, Inc., San Francisco, died September 7 from a heart attack. He was 49.

Crawford had joined United Airlines in Denver in 1940 as an equipment engineer. In '42 he joined the Pump Engineering Service Corp., Cleveland, as field manager, but later returned to the airline.

Previously he was associated with Boeing Aircraft Co., Seattle, for ten years, and prior to that he worked for Spartan Aircraft Co., Tulsa, Alexander Eagle Rock, Denver, and the American Eagle Co., Kansas City, Mo.

A native of Colorado, he attended Denver University, Western State College in Gunnison, Colorado, and the University of Washington in Seattle.

Crawford was the author of "Air Cargo Problems" a paper presented at the National Air Transport Meeting in Chicago, December, 1945. An excerpt from this paper was published in the April '46 Journal. He also wrote, "Air Transportation and Maintenance," presented to the Cleveland Section in February, 1943.

He was a member of the Institute of Aeronautical Sciences, as well as SAE.

CLARENCE EDWARDS EARLE

Clarence Edwards Earle, 60, consulting engineer, died November 25.

Earle was the originator and developer of thin film polar compounds and the first carbon monoxide indicator for aircraft. His outstanding development was in the field of lubricants, in which he originated and developed Lithium Base Greases. He also did the original work on the use of Acryloids as active Viscosity Index agents.

His interest in medical therapeutics lead to the development of a series of substituted phenyl amino salts, used in the treatment of bacterial and fungi infections. His interest in mechanical engineering lead to development of the double-seated oxygen valves which were used for safety apparatus in rescue work. He held numerous patents pertaining to couplings used widely in the industrial field, and in addition, acted as consultant to the Baltimore Engineering and Chemical Co. and B-R Engineering Co., Baltimore.

Earle was a graduate of George Washington University where he received the B.S. degree in Chemical engineering in 1923. He taught science and industrial education prior to World War I, and served as an officer in Naval aviation. He later became head of the Aeronautical Gas Section, Navy Department, with jurisdiction over helium activities and production in the first helium plant, Fort Worth, Texas.

He was head of the Chemical Research and Development Section, Bureau of Aeronautics, and served as chief chemical consultant to the Bureau until 1946.

EMERSON J. LUXMOORE

Emerson J. Luxmoore, 50, was killed in a traffic accident, November 25, in Taylor Township, Michigan. He was staff engineer in charge of passenger car body and sheet metal design for the Chevrolet Motor Div., GMC, and had been with Chevrolet for 27 years.

Before joining Chevrolet he had worked for the Detroit Edison Co. as a draftsman, but entered the automobile body engineering field in 1923. He worked at Dodge Brothers, Trippansee Body Co., Studebaker, Chrysler, and Briggs.

Luxmoore was a member of SAE's Body Activity Committee for a number of years. He was also a 32nd degree Mason, a member of Moslem Temple Shrine.

J. LOUIS BOSSART

J. Louis Bossart, partner and general manager of the Donaldson Motor Co., Pittsburgh, died September 7. He was 65.

Bossart was general manager of the company since 1929. Previously he was sales manager for the Murdoch Chevrolet Co., and prior to that did sales work for Studebaker.

Born in Latrobe, Pa., he attended the University of Pittsburgh where he studied chemistry and pharmacy. He received his Ph. G. degree after a two-year course.

FRANK D. RIEHLE

Frank D. Riehle, 32, died in an airplane crash in Albany, N. Y., September 16. He was a design project engineer for Pratt & Whitney Aircraft Division, United Aircraft Corp., East Hartford, Conn.

He had been with Pratt & Whitney since 1943, the year he graduated from the University of Louisville in Kentucky. On Riehle's application for SAE membership, Dean F. L. Wilkinson, Jr., of the University of Louisville, wrote: ". . . As a student he gave promise of success in engineering and it is my understanding that his work in industry since graduation has borne out this promise."

Nathaniel Haynes, now with Boeing Aircraft, considered Riehle, ". . . a very promising young designer."

WILLIAM H. CURTISS

William H. Curtiss, owner of Pottstown Motors. Inc., Pottstown, Pa., died October 30. He was 65.

Curtiss was at one time president and chief engineer in charge of engineering, tool design and production for Curtiss & Smith Mfg. Corp. in Pottstown. Prior to that he was self-employed as a consulting engineer designing tools, jigs, and fixtures for the auto industry.

He was born in Lansing, Mich., and attended schools there. After graduating from high school, he entered industry with Reo Motor Car Co. in Lansing. At Reo he worked in the tool room and tested automobiles.

During World War I he served in the U. S. Army, in the Detroit District, as a chief inspector of engines and trucks.

RUSSELL S. BEACH

Russell S. Beach, 63, district manager of Fiske Brothers Refining Co., Detroit, died September 16.

Beach was with Fiske Brothers for almost 35 years and was a member of SAE for 23 years. Before joining Fiske Brothers, he had been with the American Express Co.

He was a native of Bowling Green, Ohio, and attended public grade school there. His high school education was received in South Bend, Indiana.

DAVID J. BONAWIT

David J. Bonawit, chief engineer, Marshall-Eclipse Division, Bendix Aviation Corp., Troy, N. Y., died April 22. He was 60.

Bonawit was with Marshall-Eclipse since 1944. Prior to that he had been an engineer with the Manhattan Rubber Mfg. Division, Raybestos-Manhattan, Inc., for 22 years. He had also worked for the Pyrene Mfg. Co., the Ultra Violet Water Sterilizer Co., and the Watervliet Arsenal. Bonawit was author of "Friction Dynamometer," an article appearing in the October '52 "Machine Design."

ROSY FUTURE . . .

. . . ahead for heavy presses as new planes open opportunities for forgings, extrusions.

TOMORROW looks even more promising than today. That pretty much sums up the attitude of those involved in various phases of using and producing large forgings and extrusions for aircraft.

This feeling was expressed by heavy press builders, operators, and airframe engineers at heavy press sessions jointly sponsored by IAS, ASME, and SAE at the Hotel Statler, New York, December 1.

Said F. E. Hyatt, Jr., of Republic Aviation, "As our airplanes increase in speed, more and more parts appear which will give us a weight advantage as forgings." He said that planes are becoming increasingly denser and only now are important weight savings from forgings beginning to show up.

He spotted places where forgings already are whittling away weight from Republic's F-84F swept-back wing fighter . . . 55 lb from the forward bulkhead, 10 lb from the rear bulkheads, 7 lb from an auxiliary spar. Hyatt looks ahead to even greater savings in forthcoming airplane models as forgings become more readily available and more opportunities to use forgings present themselves.

In addition to weight saving, forgings are expected to save production manhours by reducing assembly time. Designers also feel they can realize weight savings with forgings without increasing size of parts.

Gains Ahead for Extruders

Extrusions too figure significantly in airframe weight-saving design of the future. Big presses now on the design board hold promise of extruding complicated shapes at higher speeds than existing equipment. For example, Loewy Construction Co., designer and builder of heavy presses, is now designing a 20,000-ton extrusion press. An automatic die-changing system built into this press will make possible step extrusions with aluminum.

H. Albers, G. Krause, and A. Greensite, of Loewy, described a 12,000-ton extrusion press at Curtiss-Wright. This installation promises to do an even better job of extruding steel propeller blades than the 5500-ton press at the Air Force plant in Adrian, Mich. The Adrian press extrudes a 10-ft propeller blade from a 320-lb alloy steel billet. The blade has good physicals, smooth finish, and needs little machining. The 12,000-ton press will accentuate these advantages, and will extrude heavier sections and at higher extrusion rates.

This same press will also be able to produce hollow extrusions and internal taper extrusions. It will be able to do a combined forging and extrusion job.

Unveiling German Press

Right now the Aluminum Co. of America is running tests on a 14,000-ton German-built extrusion press. It's at Alcoa's Lafayette, Ind. plant. Alcoa's C. R. Anderson said it will make possible extrusions that:

- Are longer.
- Have better dimensional characteristics.
- Are produced at a faster rate.

Anderson looks for a rosier tomorrow with this press. Up until now, the press has created problems for its operators. Problems of surface wear and alignment have cropped up in preliminary runs with the machine.

But Alcoa is overcoming these pesky obstacles and expects to have the 14,000-ton extrusion press in full operation shortly.

SAE National Meetings . . .

Meeting	Date 1954	Hotel
Passenger Car, Body, and Materials	March 2-4	Hotel Statler, Detroit
Production Meeting and Forum	March 29-31	The Drake, Chicago
Aeronautic Meeting Aeronautic Production Forum, and Aircraft Engineering Display	April 12-15	Hotel Statler, New York City
Summer	June 6-11	The Ambassador, Atlantic City, N. J.
West Coast	Aug. 16-18	Hotel Statler, Los Angeles
Tractor and Production Forum	Sept. 13-16	Hotel Schroeder, Milwaukee

AIR CARGO EXPERTS . . .

. . . are more concerned with overall transit time and with costs than with plane speed, at fifth annual Air Cargo Day sessions, which SAE cosponsored . . .

THE relatively slow but economic helicopter and the piston engine were the stars of the four sessions, which were this year spread out over two days, Nov. 30 and Dec. 1, at the Hotel Statler in New York. The sessions were part of the Annual Meeting of the American Society of Mechanical Engineers and were cosponsored by SAE as well as the Institute of the Aeronautical Sciences, the National Security Industrial Association, and the Transport Air Group.

Overall transit time can be cut more, at less cost, by speeding up transfer from the shipper to the airplane than by speeding up the airplane, it was brought out. New York Airways is proving that point with the helicopter. For example, NYA carries mail from postoffices to airports in the Greater New York area at a saving of anywhere from 15 minutes to half a day or more.

The big time saving lies in the direct loading from the helicopter to the plane on the field. Fifteen minutes after the helicopter sets down, all the mail is stowed in the outgoing airplane. No intermediate handling is required, as is the case with ground transport to the airport. And, of course, the helicopter makes very much better time across cities than traffic-slowed trucks do.

NYA's economic studies have shown that it is not feasible to pick traffic off a roof unless the traffic is generated in the building itself. Transporting either people or packages from the ground to the roof is too slow and costly, especially in buildings without special elevator capacity. NYA and the Port of New York Authority are, however, considering landing helicopters on barges moored off Manhattan's Midtown Skyport.

NYA currently flies 30 hr per day with its five ships. Maintenance requires about 6 man-hours per flying hour. The company looks forward to reduced maintenance cost per ton-mile on new and bigger helicopters, when they are available.

That day isn't far off apparently. Helicopter operators were told that builders hope to have big H-21-type commercial helicopters on the market within a year or two.

Ultimately, commercial and military air cargo operators may be blessed with pack-type helicopters. One idea is to use a pack similar to the body of a highway trailer. The pack can travel on a dolly drawn by a highway tractor to the airport, and a small tractor will position the dolly on the field. Then the helicopter straddles the pack, the fastenings between pack and helicopter are secured, the dolly is removed, and the helicopter takes off.

Making packs strong enough to withstand road shocks adds weighty structure that is only a liability in flight. So packs may actually be built for only very limited over-the-road haulage. Even so, the pack concept will cut costs by enabling the helicopter operator to improve utilization of his expensive power unit. The helicopter doesn't have to wait around while loading and unloading is accomplished. As soon as it discharges one pack, it can pick up another already loaded pack and be off earning money again.

Costs of developing helicopters of this type may be borne largely by mili-

At Luncheon Honoring Engineers' Contribution to Powered Flight . . .

. . . **Dr. William F. Durand,** first chairman of the National Advisory Committee for Aeronautics, received a special citation for his contributions to powered flight from the three organizations sponsoring the luncheon—ASME, IAS, and SAE. Jerome C. Hunsaker, current chairman of NACA, made the presentation.

Partly hidden behind Hunsaker are Igor I. Sikorsky (left), who spoke at the luncheon, and Roy T. Hurley, president of Curtiss-Wright Corp., who presided.

Sikorsky, speaking on "Aviation—1909 to 1969," gave this as the secret of the Wright brothers' success as aeronautical engineers: They realized that to build a plane that would fly was not enough. It was necessary also to train a man to fly it.

He urged engineers, as they continue to contribute to aviation progress, to keep in mind the humans the aircraft serve—and not to scorn "wild" ideas, as the concept of powered flight was once regarded.

tary production. At least, military air cargo leaders are very much interested in cargo-carrying packs and also in packs outfitted as field kitchens, hospital units, communication centers, Arctic housing units, and electronics repair shops. They see great value in units that can be set down any place in the world, ready to operate.

The one fault commercial operators found with the pack idea is that it isn't practical for multi-stop routes where no station generates enough traffic to completely fill a container. (Pack proponent's comeback: "Maybe that's a problem for airlines' sales departments.) Mixed passenger-cargo operation is the way the airlines see to provide adequate frequency of service plus space and speed.

Economic considerations will dictate use of piston engines to power both passenger and cargo transports for some years to come, according to predictions made by speakers and discussers at the meeting. The feeling was that it will take that long to develop truly economic turbine transports and put them into regular commercial service.

This is the premise on which Wright Aeronautical has brought out its Turbo Compound engine for commercial use, it was explained. (The Turbo Compound is an 18-cylinder piston engine compounded with three blow-down turbines which take power out of the exhaust and return it to the crankshaft.) It's WAC's belief that there will be another go-around on piston-engine transports before turbines are ready and that the powerful, economical Turbo Compound is the engine for the pre-turbine interim.

Fuel consumption of the Turbo Compound was said to be 0.38-0.39 lb fuel per bhp-hr—more economical even than the long-sought goal of 0.40. And WAC is working on several improvements (like variable overlap cams and more efficient internal aerodynamics) to drive the fuel consumption figure even lower, it was revealed.

One airline that has ordered a fleet of Turbo Compound equipped DC-7's figures that the planes will be worth while if they serve as the "lead" plane for three years before turbines take over. This airline expects actually to operate its DC-7's with Turbo Compounds for 10 years, discussion disclosed.

In each of the four sessions, operators were urged to look further into the economics of ground and flight equipment—that in the blueprint stage as well as that in use. Plenty of proposals have been put forward. . . . Now we need to have them evaluated in terms of dollars for commercial operations and in terms of lives for military operations, was the sentiment. Studies like the one Stanford Research Institute undertook for the Navy drew repeated praise.

Proper Engine Choice

M. J. Waclawek, Borg-Warner Corp.

Based on paper "Torque Converter for Industrial and Commercial Vehicles" presented at SAE Chicago Section, Chicago, Dec. 11, 1952.

THE characteristics which make an engine seem desirable before a torque converter is added are often handicapping to the equipment builder in working out a converter application. Choice of engines, therefore, is highly important if maximum advantages are to be had from a torque converter application.

Low-speed engine B (Fig. 1), for example, has been highly valued because its torque increases where more load is encountered, resulting in less tendency to stall out and less need for down-shifting. With a torque converter this engine cannot stall out and cannot even be loaded down to the speed of its best torque. High-speed engine A sacrifices some torque at stall, but has its best torque within the operating range and delivers more horsepower for the same displacement.

When output torque is compared with output speed of the converter for engines A and B (Fig. 2), the high-speed engine shows marked advantage because the gain in torque occurs in a speed range where the engine will do most of its operating.

The importance of choosing the correct capacity torque converter is illustrated in Fig. 3. Here are three different size engines used with the same converter. Each engine has its own governor speed, the biggest having the lowest speed and the smallest the highest. The curve marked "stall point" denotes the maximum torque ratio and occurs when the output speed is zero. The "clutch point" curve is the point where the torque ratio becomes one and the torque converter starts acting as a fluid coupling. Between the two curves there is torque multiplication, starting with maximum ratio at stall and diminishing gradually until it becomes one at the clutch point.

Engine A is too large for the converter because (1) its maximum torque will never be utilized since it occurs at a lower speed than the stall speed of the converter and (2) the governor starts diminishing engine torque while the torque converter is still multiplying, which means the converter input torque will be less than what the engine is capable of supplying at that speed.

Engine B is near the optimum size for this converter. The engine torque peaks at stall and the governor starts acting beyond the clutch point, well in the coupling range. Engine C is probably too small because it has too low a stall speed for most applications and comes out of torque multiplication too soon.

To throw further light these three engines and the same converter are plotted against output characteristics in Fig. 4. Engine A is shown without torque converter, with a converter governed at 1800 rpm, and ungoverned. Best performance is had with the ungoverned torque converter. When a governor is added and it starts acting in the torque conversion range, a large portion of the torque converter potential is lost. From an output speed of 1250 rpm to the governed speed, engine A without torque converter gives decidedly more output torque than with a converter when governed.

On this same curve engine B gives an optimum utilization of a torque converter for best performance. If, however, engine B is used with the same load intended for A, to get the same output speed for B as for A, the rear axle or gear box ratio will have to be changed by 1.168 because the two engines are governed at different speeds. Engine B then has an output torque at stall of 375 lb-ft as compared with 440 lb-ft for engine A. In the operating range engine B will be running faster because its governor setting is higher. Thus, its operating efficiency will be higher because the torque converter is in the coupling range at this point, and coupling efficiency increases with engine speed.

It will be seen that the smaller engine B will almost equal the stall performance of engine A and surpass it in the operating range. Engine C, on the other hand, is considered too small for the torque converter shown in that it gets out of ratio too soon. Although coupling efficiency is very good at the governed speed, it is usually desirable to have torque multiplications over a large range of output speeds.

(Complete paper on which this abridgment is based will appear in 1954 SAE Transactions. It is also available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

Vital for Torque Converter Application

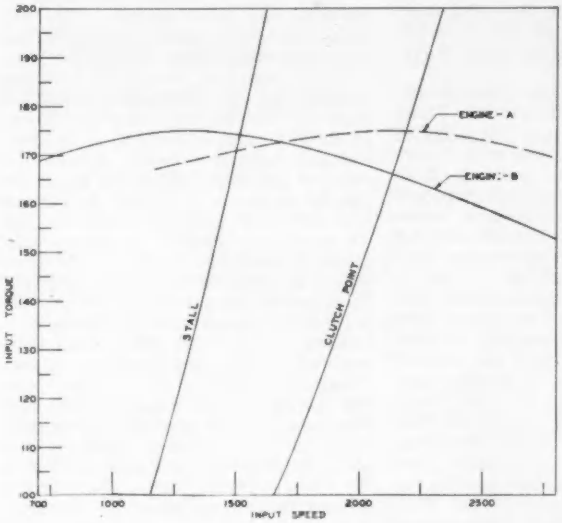


Fig. 1—Comparative performance between low-speed engine B and high-speed engine A shows latter has best torque within operating range and delivers more horsepower for same displacement

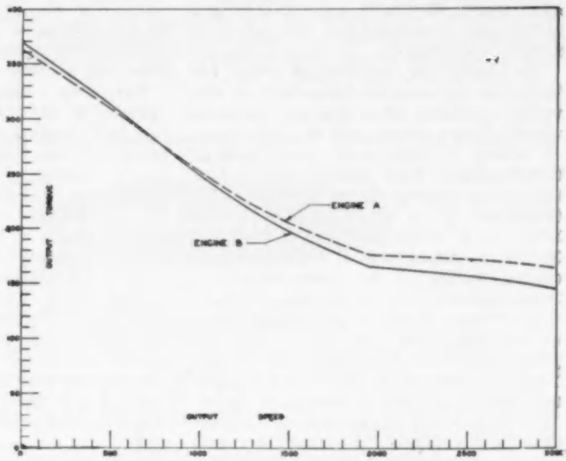


Fig. 2—Illustrating output torque versus output speed of the converter with engines A and B. Engine A gain in torque occurs in main operating range

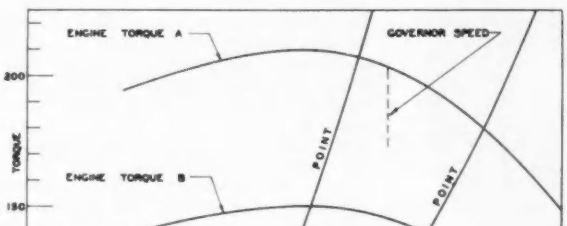


Fig. 3—Comparative performance of three different size engines with same converter. Engine A is too large for the converter, engine B is near the optimum size, while engine C is too small

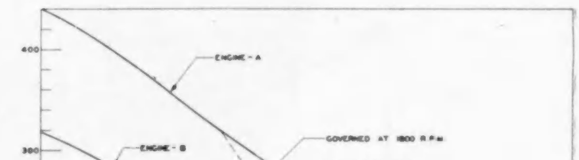


Fig.4—Plotting the same three engines with converter (as shown in Fig. 3) against output characteristics shows optimum utilization of a torque converter by engine B, to get best performance

New Problems Face Airframe Engineering

Based on paper by

E. H. LaBOMBARD

Douglas Aircraft Co., Inc.

CHANGES in material properties due to the operating temperatures of high-speed airplanes have introduced some new concepts for the aircraft structures designer.

To handle the problem of creep, for instance, it becomes necessary to develop a system of numerical analysis which allows evaluation of the margin of safety. Under creep conditions of temperature, 0.2% permanent deformation can occur at stresses less than the static yield stress, if the load is held for a sufficient time. There is, therefore, an artificial "yield point" corresponding to a given time and temperature. The numerical value of this "creep yield" is determined first by estimating the total time the applied load will be acting on the structure, and then estimating the temperature that will occur simultaneously.

It is a neat trick but there does exist a good deal of history on frequency of load applications in service for several types of aircraft, hence some numbers can be assumed. At this time and temperature, the 0.2% set stress can be determined. It is naturally lower than the short-time yield stress for this temperature and will be the allowable for all parts designed by yield criteria. Due to the convention of using design loads and ultimate stresses for design, if "creep yield" is less than two-thirds of the static ultimate at this temperature the design allowable for all parts will be correspondingly reduced.

The creep curves (Fig. 1) show this relationship for stainless steel. From these it can be seen that the yield stress for an airplane spending most of its high-load life at 500 F is the same as for a missile having a short-time life at 1000 F.

Corrosion resistance is substantially reduced at these temperatures. There are two reasons for it. The elevated temperatures increase the rate of corrosive reactions, and, perhaps more significant, after prolonged exposure to elevated temperatures, most materials undergo a metallurgical change that reduces corrosion resistance. The critical conditions at which this change occurs vary with temperature and time of exposure for all materials. For this reason, the best material for corrosion resistance should be selected on the basis of actual operating temperature. (Paper "The Effect of Temperature on Aircraft Structural Design" was presented at SAE National Aeronautic Meeting, Los Angeles, Oct. 1, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

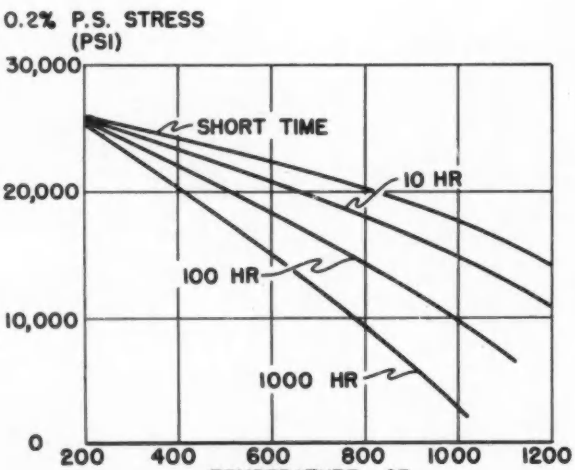


Fig. 1—These creep curves for stainless steel illustrate the point that the yield stress for an airplane spending most of its high-load life at 500 F is the same as for a missile having a short-time life at 1000 F

Open Pit Mining Needs Huge Equipment

Based on paper by

E. R. DICKIE

Bagdad Copper Corp.

WE need larger and more efficient equipment to handle more tons of material per dollar spent. This will reduce costs and make possible mining and processing lower grade ores.

If, for example, we could drill and blast all of our overburden and then bulldoze the broken material downgrade to a common haul road for loading and hauling to waste dumps, the cost of moving material could be greatly reduced. Available bulldozers are not large enough to do the job. To meet requirements a dozer must move at least 24 cu yd. 1000 ft down a 30% grade at three minute intervals. It is self-evident that unit costs are inversely proportional to equipment capacities where the job warrants the use of large equipment. (Paper "Larger Equipment Needed for Open Pit Mining" was presented at SAE National Tractor Meeting, Milwaukee, Sept. 15, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

Based on Discussion

Harold H. Hall, General Motors Corp.

When we experiment with larger capacity equipment we are faced with some limiting factors and solutions must be obtained before the frontier can be extended any great distance. Powerplants must be developed with sufficient horsepower to give this large equipment satisfactory performance. Tires must have sufficient capacity to sustain the loads that will be imposed upon them. Usually the smaller the equipment (15- to 25-ton capacity), the more flexibility of usage. The larger the equipment (25- to 50-ton capacity), the greater the production obtained in a given period of time and the possibility of cost reduction. It would be dangerous to say positively that cost reduction automatically accompanies the larger size units.

R. H. Kress, Dart Truck Co.

We are entering a new phase of larger truck design with the introduction of 50- to 60-ton capacity trucks. As our design work advanced it became obvious that the scaling up process had reached its practical limit in the 25- to 30-ton models and that much could be gained in larger trucks by a new approach to design. As a result we were able to develop a 60-ton truck approximately 2 ft narrower, 4 ft shorter, and 6 in. lower than would

have been possible by scaling up. Furthermore, this new design affords a turning radius closely approaching the 25- to 30-ton size which would have been impossible with conventional design. Strangely enough, the "bugs" we ran into involved the few scaled up components rather than the new features.

Slip Clutch Lowers Tractor Starting Load

Based on paper by

FRED M. POTGIETER

Borg-Warner Corp.

IMPLEMENTS with high inertia, such as balers and forage harvesters, can impose starting loads on farm tractor power take-off shafts which are more than four times the average running torque. To eliminate this high starting torque, a suitable safety slip clutch can be placed in the power take-off driveline. Such a clutch need not greatly reduce the capacity of the implement, and what is more, it will probably pay for itself in part through the saving in cost of the driving mechanism.

Illustrative of what a slip clutch can do is shown by a test with a baler. Using a large tractor, without slip clutch, the maximum starting torque was 25,400 lb in. and the maximum running torque 5380 lb in., or a ratio of five to one. With slip clutch installed the starting torque dropped to 6750 lb in., while the running torque remained 5380 lb in. (Paper "Universal Joint Applications to Power Take-Off Drives on Farm Machinery" was presented at SAE National Tractor Meeting, Milwaukee, Sept. 17, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

Hydraulic Drives Benefit Accessories

Based on paper by

C. L. SADLER

Sundstrand Machine Tool Co.

ALTITUDE operation presents no problem to a hydraulic transmission for accessory drives, since the working circuit is completely independent of ambient pressures. Therefore, as much power can be delivered at extreme altitudes as on the ground, a feature which is not readily attainable in most other types of transmissions. Similarly, because they are enclosed from the elements, hydraulic units are unaffected by humidity, sand and dust, salt spray, fungus, and kindred adverse atmospheric phenomena.

In keeping with accepted practice for military application, we have designed all units for 500-hr overhaul life. On the B-36 units, however, the established removal time is now up to 800 hours and we see no fundamental reason why 1000 or more hours between overhauls cannot be achieved with appropriate design for longer life, assuming at least average maintenance in the field.

Complete overhaul of B-36 units is, and has been for several years, handled entirely at the Air Force depot without appreciable assistance from company personnel. The Navy is now in the process of setting up similar overhaul procedures on units being delivered to them.

We have felt that one of the fundamental requirements in the design of this type of mechanism should be a freedom from any specialized ma-

chining or assembly problems which would affect life adversely or preclude expeditious overhaul of the units at an established military or commercial overhaul facility. This has been accomplished, and when considered in conjunction with the high performance characteristics obtainable in a hydraulic transmission, we hope will result in others sharing our own convictions that such units have a useful and expanding place in new military and civilian aircraft. (Paper "Hydraulic Power Transmission for Accessory Drives" was presented at SAE National Aeronautic Meeting, Los Angeles, Oct. 2, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

Air Tanker Systems Need Better Components

Based on paper by

THEODORE R. FARRINGTON

Wright Air Development Center, USAF

THE art of transferring fuel from a tanker aircraft to a receiver aircraft during flight was originally conceived as a temporary measure to extend the range of B-50 bombers until newer, longer-range airplanes were available. However, this operation became so useful for many military purposes that in-flight refueling has now become an important and accepted concept in the design of new aircraft.

Much remains to be done to make refueling systems more satisfactory, and to this end new and better components are needed. Among the items that will be required are:

- Probe nozzles and reception coupling units complying with USAF specifications and meeting the standard configuration envelope to be set by the Wright Air Development Center.
- Improved materials and construction methods for in-flight refueling hoses.
- Compact, lightweight, low-input-power hose-stowage handling equipment.
- Fuel pressure regulation equipment of simple design capable of maintaining a constant refueling pressure at the inlet of the refueling coupling.
- Refueling pump driving motors, both air and hydraulic, of high horsepower capacity and speed ratings suitable to increase the output pressure from present pumping equipment.

(Paper "Tanker Aircraft Refueling Systems" was presented at SAE National Aeronautic Meeting, Los Angeles, Oct. 1, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

Students Enter Industry

ERNEST A. KUSSMAUL (Academy of Aeronautics '50) is employed as a tester by the Stratos Division of Fairchild Airplane & Engine Corp., Bayshore, N. Y.

ANTHONY M. MAGGIO (West Coast University '53) is a test equipment designer for AiResearch Mfg. Co., Los Angeles.

GEORGE W. LANDON (Michigan State College '53) is now a second lieutenant in the U. S. Air Force.

JOHN R. CANAN (Purdue '53) has left the Cummins Engine Co., Inc., Columbus, Indiana, to enter military service. Canan was a test engineer at Cummins.

RONALD A. FUHRMAN (Wayne University '52) is in the U. S. Army, assigned as an industrial engineer in the Army's scientific and professional personnel program. He is at the Red River Arsenal, Texarkana, Texas.

WILLIAM ANTHONY BREAUX (Detroit Institute of Technology '53) has joined the Excello Corp., Detroit, as an electrical layout man.

CHARLES A. BERRY (Missouri School of Mines '53) is in the U. S. Army, stationed at Fort Dix, N. J.

JOHN THOMAS KOSINSKI (University of Michigan '53) has left the Ford Motor Co., Dearborn, Mich., to enter the Armed Forces.

JOHN CALVIN (Swarthmore '53) is now at the Oak Ridge School of Reactor Technology, Oak Ridge National Laboratory, Tenn.

GEORGE B. DABINETT (Syracuse University '53) is a junior engineer at Chance Vaught Aircraft, Division, United Aircraft Corp., Dallas.

EDGAR P. DOLLAR (University of Miami '53) is employed by Babcock & Wilcox Co., Miami, as an engineer.

JOHN S. GABEL (Pennsylvania State College '53) is an engineer for the E. I. du Pont de Nemours & Co., Inc. at the Savannah River Plant, Augusta, Ga.

RAY FRANKLIN GONG (Purdue '53) is now a production engineer in the Cummins Engine Co., Columbus, Indiana.

LESLIE J. JACOBSON (University of Washington '53) is now a junior engineer with North American Aviation, Inc., Los Angeles.

Continued on Page 102

Students Enter Industry

continued

HOWARD E. LANG (Lawrence Institute of Technology '53) is employed as a quality control engineer by the Packard Motor Car Co., Detroit.

RAYMOND E. STERN (Lehigh University '53) is a junior mechanical engineer in the Dept. of Public Works, New York.

CLARENCE E. YOUNGMAN (Parks College of St. Louis University '51) has been employed by the Goodyear Aircraft Corp. of Akron as a liaison engineer.

GEORGE C. KOURIS (University of Southern California '53) is a development engineer for the Goodyear Tire & Rubber Co., Los Angeles.

JAMES R. GRIFFITH (Yale University '53) is now a project engineer in the Research Division of the United Shoe Machinery Corp., Beverly, Mass.

LT. COL. WILLIAM A. HINTERNHOFF (U.S.M.A. '39, Purdue '53) is an Army field forces liaison officer at the Detroit Arsenal, Center Line, Mich.

VICTOR R. BERENT (Stevens Institute of Technology '53) has been employed by Combustion Engineering, Inc., New York, as a mechanical engineer.

SAUL J. DuBOVIS (Northrop Aeronautical Institute '53) is now a junior engineer for the Lockheed Aircraft Corp., Burbank, Calif.

DONALD JOHN FERGLE (Illinois Institute of Technology '53) has joined the Packard Motor Car Co., Detroit. He is a design analyst in the marine dept.

JOHN E. FISCHER (Bradley University '53) is a junior design engineer with the North American Aviation Co., Columbus.

RUSSELL H. THOMAS (Georgia Institute of Technology '52) is now a project engineer with the Al-Fin Division of National Steel & Shipbuilding Corp., San Diego.

JOHN V. FRONT (Parks College '53) has joined North American Aviation, Inc., Columbus, Ohio, as a draftsman-engineer in the aerodynamics dept.

RICHARD D. FOLLRATH (Michigan College of Mining & Technology '53) is now a field engineer with the AC Spark Plug Div. of General Motors, Milwaukee.

MELVIN CHRISTIANER (Parks College '52) is a stress engineer with the MacDonall Aircraft Corp.

WILLIAM R. HELLNER (Carnegie Institute of Technology '53) has joined the Cooper-Bessemer Corp., Mount Vernon, Ohio, as an engineering trainee.

MASAMIZLI KITAJIMA (Academy of Aeronautics '53) is connected with United Airlines at LaGuardia Airport, New York, as an engine and airplane mechanic.

LELAND F. KIRBY (Northrop Aeronautical Institute '53) is now a liaison engineer with Douglas Aircraft Co., Torrance, Calif.

DON PERKINS (Parks College '53) is enrolled in the graduate student training program at Westinghouse Electric Corp., Pittsburgh, Pa.

CHESTER L. MERCER (Tri-State University '53) is now a structural engineer with the Lukens Steel Co., Coatesville, Pa.

Students Enter Industry

continued

GEORGE W. THIMOT, JR. (University of Massachusetts '53) is an engineering trainee in the service and erection department of Combustion Engineering Inc., New York.

RONALD R. REESE (University of Idaho '53) is now a second lieutenant in the U. S. Army, stationed at Ft. Belvoir, Va.

KEITH E. BUCK (University of California '53) is an ensign in the U. S. Navy and is stationed aboard the U. S. S. Hanna.

LYNN KEITH (Northrop Aeronautical Institute '53) is a weight analyst at the Downey Plant of North American Aviation, Inc.

E. A. PARKISON (Northrop Aeronautical Institute '53) has joined Northrop Aircraft as an engineering assistant.

LOUIS A. VAUGHN (Northrop Aeronautical Institute '53) has joined Lockheed Aircraft, Inc., Burbank, Calif., as a junior engineer draftsman "B."

JOHN J. HUBBARD (Washington State College) is in the U. S. Air Force as an aviation cadet, 3606th Student Squadron, Ellington Air Force Base, Texas.

T. LOUIS DeYOUNG (Michigan State College '52) is a Naval Aviation Cadet.

CARL F. THELIN (University of Wisconsin '53) is a junior engineer for the Line Material Co., Milwaukee, Wis.

ARCHIBALD R. NEWTON III (Chrysler Institute '53) is in the U. S. Air Force as a project engineer. He is stationed at Wright Air Development Center, Wright-Patterson Air Force Base, Ohio.

WILL R. PIERIE (Ohio State University '53) is in training at the General Motors Research Laboratories, Detroit.

PAUL J. WILLIAMS (Massachusetts Institute of Technology '53) is a project engineer in the advanced vehicles department of Ford Motor Co., Dearborn, Mich.

SAMUEL GALETAR (University of Colorado '53) is an engineer for Fire-Stone Tire & Rubber Co., Akron, Ohio.

L. R. LATCH (Southern Methodist University '53) is a design engineer for Consolidated Vultee Aircraft Corp., San Diego.

ROBERT E. GILLINGHAM (California Institute of Technology '53) is

Continued on Page 104

Students Enter Industry

continued

an engineering assistant "A" with Northrop Aircraft, Inc., Hawthorne, Calif.

LEONARD EDELSTEIN (West Coast University '53) is a diesel test engineer for Continental Motors Corp., Muskegon, Mich.

KARL SCHWARZE (Chrysler Institute '53) is a test and development engineer in the body engineering department, Central Engineering Division of Chrysler, Detroit.

THOMAS E. MILLER (General Motors Institute '53) is an engineer in the Proving Ground Section of GMC, Milford, Mich.

GLEN O. KERREBROCK (Oregon State College '50) has joined Boeing Airplane Co., Seattle.

WILLIAM FREDERICK CHRISTENSEN (Oregon State College '53) is in the U. S. Army at Aberdeen, Md.

SISTO E. MARSICO (University of Pittsburgh '53) is an engineering draftsman for North American Aviation, Los Angeles.

ROBERT J. MOORE (Michigan State College '53) is with the Aircraft Engine Division of Continental Motors Corp., Muskegon, Mich. He is a production engineer.

WALDON SCHMIDT (San Diego State College '53) is a mathematician in structural engineering for the Ryan Aeronautical Co., San Diego.

JACK AZOFF (Northrop Aeronautical Institute '53) is now technical representative for North American Aviation, Los Angeles.

RICHARD ALLEN HUDSON (Loyola University of Los Angeles '53) is an engineering trainee, Western Gear Works, Lynwood, Calif.

JOSEPH J. LUSCO (University of Illinois '53) has joined International Harvester Co., Melrose Park, Illinois, as a test engineer.

JOHN WILLIAM MORGAN II (Carnegie Institute of Technology '53) is now a junior engineer in the Missile Division of Bendix Aviation Corp., Mishawaka, Indiana.

FRED W. ST. JOHN (Northrop Aeronautical Institute '53) is an engineer assistant "A" the Northrop Aircraft, Inc., Hawthorne, Calif.

JOHN GRAHAM BRUCE (University of British Columbia '53) is now assistant equipment manager for Mannix, Ltd., Calgary Alberta, Canada.

ANDREW J. BOZZELLI, JR. (Johns Hopkins University '53) is a research

Students Enter Industry

continued

engineer for the Sun Oil Co., Marcus Hook, Pa.

CHESTER J. SELDEN (Wayne University '53) has joined the Ford Motor Co., Dearborn, Mich. He is a materials handling engineer.

ANGELO JAMES SKALAFURIS (Illinois Institute of Technology '53) is a junior mechanical engineer in the Chicago Midway Labs, University of Chicago.

MORTON SCHLER (University of Miami '53) is employed as a mechanical engineer for the National Advisory Committee for Aeronautics, Langley Field, Virginia.

ALAN F. KINDRICK, (California State Polytechnic College) is an experimental machinist in the U. S. Army, Arctic Test Branch, Alaska.

HUBERT P. DAVIS (Texas Agricultural & Mechanical '51) is now a group aircraft maintenance officer, 4th Fighter Interceptor Group.

C. A. LINDBLOM, JR. (Case Institute of Technology '52) is now with the International Harvester Co.

JOSEPH A. NAUGHTON (Chrysler Institute '53) has left Chrysler Corp. to enter the U. S. Army. He is stationed at Fort Knox, Ky.

EDWARD MARTIN BAZETT (Tri-State College '53) has joined the Lycoming-Spencer Division of Avco Mfg. Corp. as a draftsman.

DAVID J. HLUBEK (General Motors Institute '53) is at the Detroit Stamping Unit, Fisher Body Division, GMC, doing tool and die construction estimating.

LOUIS A. KOVACS (Fenn College '53) is with Reliance Electric & Engineering Co., as a mechanical engineer.

ARTHUR R. SHIPE, JR. (Ohio State University '53) is a tester in the Frigidaire Division of General Motors.

WILLIAM R. KUHNLE (New York University '53) has joined the Curtiss-Wright Aeronautical Division in Wood-Ridge, N. J.

EDWARD E. DONALDSON (Chrysler Institute '53) is a development officer in the U. S. Air Force, stationed at Wright Air Development Center, Wright Patterson AFB, Ohio.

JACK M. ANGEVINE (Colorado University '53) is now in the U. S. Army, Fort Knox, Ky.

RAYMOND JAMES SACKS (Rolla

Continued on Page 106

Students Enter Industry

continued

School of Mines '53) is serving with the U. S. Navy. He was with the Fisher Body Division of GMC, St. Louis, Mo.

RALPH J. PETILLO (University of New Hampshire '53) has entered military service. Petillo was design engineer for Goodyear Aircraft Corp., Akron, Ohio.

RICHARD D. SCHWARTZ (Illinois Institute of Technology '54) is a trainee in the co-operative program of the Sunbeam Corp., Chicago, Ill.

EDWARD H. BACON (California State Polytechnic '53) has joined the Ethyl Corp.

WINFIELD SCOTT BAYLESS (Johns Hopkins University '53) is now a junior engineer for York Corp., York, Pa.

BURWYN B. BENDER (Chrysler Institute '53) is an engineer in the missile branch of Chrysler Corp., Detroit.

JARVIS ANDREW HOPPLER (Missouri School of Mines '53) is employed as a test engineer by the General Electric Co., Schenectady, N. Y.

JAMES D. OSWALT (General Motors Institute '53) is with the Chevrolet Motor Division, GMC, in Saginaw, Mich. He is doing tool engineering and design work.

WALTER B. STOUT (Northrop Aeronautical Institute) is now a flight engineer for TWA, Los Angeles International Airport.

RICHARD VAN ALEXANDER (Texas Agricultural & Mechanical College '53) is a junior sales and technical service engineer for Humble Oil & Refining Co., Houston, Texas.

STAN J. KUKAWKA (Lawrence Institute of Technology '53) is now a research engineer for Ethyl Corp. in Ferndale, Mich.

ROBERT JOHN KEYES (Wayne University '53) is a product test engineer for Ford Motor Co., Dearborn, Mich.

HENRY G. KEE (University of Massachusetts '53) is an engineer for the Boston Edison Co.

LAWRENCE E. COLBERT (University of Bridgeport '53) is an experimental test engineer for Curtiss-Wright Corp., Wright Aeronautical Division, Wood-Ridge, N. J.

JOHN RODGER TULACH (Illinois Institute of Technology '53) has joined International Harvester Co. at Melrose Park, Ill., as a design engineer. He is in the engine section, advanced design group.

Students Enter Industry

continued

ROGER VOORHEES (Fenn College '53) is a management trainee with Ex-Cell-O Corp., Detroit.

WILLIAM R. THOMSEN (Academy of Aeronautics '53) is with Pratt & Whitney Aircraft, Division United Aircraft Corp., East Hartford, Conn., as an experimental assembler.

EDWARD A. PETERSON (University of Pittsburgh '53) has joined Westinghouse Air Brake Co., Wilmerding, Pa., as a pneumatic engineer trainee.

RICHARD M. REBER (Pennsylvania State College '53) is a junior engineer for Piasecki Helicopter Corp., Morton, Pa.

AUBREY N. SHEA, JR. (Tri-State College '53) is with Federal Telephone and Radio Corp. in Clifton, N. J., as a junior engineer.

JAMES M. KARTH (University of Wisconsin '53) is at the Allison Division of GMC, Indianapolis, as a test cell engineer.

HAROLD MARTIN OLDEN (University of Washington '53) is a junior engineer "B" with Boeing Airplane Co., Seattle. He is in the engineering service department.

LAWRENCE J. SULLIVAN (Agricultural & Mechanical College of Texas '53) is an engineer for Sivalls Tanks, Inc., Odessa, Texas.

EMILIO L. POLI (Wayne University '53) is a technical service engineer for Dow Chemical Co., Midland, Mich.

DAVID T. GEDDIS (Oklahoma University '53) is an assistant engineer in the tool design department of Western Electric Co., Burlington, N. C.

RICHARD A. RATHWEG (Tri-State College '53) is with Boeing Airplane Co., Seattle, as a junior engineer "B."

MYRON S. JACKSON (Northrop Aeronautical Institute '53) is with North American Aviation, Downey, Calif., as a draftsman.

JOSEPH R. de MARTINO (Purdue '53) is a project engineer for GMC, Detroit.

SEIJI KAMI (Stanford University '53) is in the Limit Controls Division of General Controls Co., Glendale, Calif., as a design engineer.

ERIC A. TEDDLIE (Cornell University '53) has joined Bendix Radio Division, Bendix Aviation Corp., Baltimore, as a mechanical engineer.

Continued on Page 108

Students Enter Industry

continued

DELL BRAMBLE (Tri-State College '53) is with Clinton Machine Co., Clinton, Mich., as a development engineer.

DALE D. SEDLAK (California State Polytechnic College '53) is now with Consolidated Vultee Aircraft Co., San Diego, as a service engineer.

JAMES D. SYMONS (Michigan College of Mining & Technology '53) is in training at the Research Laboratories Division of GMC, Detroit.

LEO G. FOXWELL (University of Wisconsin '53) is a development test engineer for the Hamilton Standard Division, United Aircraft Corp., Windsor Locks, Conn.

LELAND F. KIRBY (Northrop Aeronautical Institute '53) is with Douglas Aircraft Co. at Torrance, Calif., as a liaison engineer.

RAYMOND N. KLOOS (Ohio State University '52) has joined Boeing Airplane Co., Seattle, as a junior design engineer.

HAROLD R. SCIBBE (Fenn College '53) is in the field test section of Thompson Products, Inc., Cleveland, as a junior test engineer.

W. J. JOYCE, JR. has been appointed manager of market research for the Timken-Detroit Axle Division of the Rockwell Spring and Axle Co. Joyce was sales manager of the clutch department, Dana Corp., Toledo.

HERMAN L. IZOR (General Motors Institute '53) is a tool engineer for the Inland Mfg. Division, GMC, Dayton, Ohio.

CHARLES S. ADAMOVIC (Northrop Aeronautical Institute '53) is now an aeronautical engineer with Northrop Aircraft, Inc., Hawthorne, California.

PETER C. NYE (California State Polytechnic College '53) has become a mechanical engineer trainee in the Shell Oil Co., Ventura, Calif.

HAROLD WANASELJA (Stevens Institute of Technology '52) is with the California Standard Oil Co., Perth Amboy, N. J., as a project engineer.

GEORGE T. VELZ (Parks College of Aeronautical Technology '53) is a liaison engineer for Kaman Aircraft Corp., Bloomfield, Conn.

GEORGE W. SMITH, JR. (Northrop Aeronautical Institute '53) is now an engineering draftsman for Land-Air, Inc., Cheyenne, Wyoming.

New Members Qualified

These applicants qualified for admission to the Society between Nov. 10, 1953 and Dec. 10, 1953. Grades of membership are: (M) Member; (A) Associate; (J) Junior; (SM) Service Member; (FM) Foreign Member.

Atlanta Group

Charles Briscoe Sanford, Jr. (A), Cecil R. Stockard (M).

Buffalo Section

Lawrence C. Dermond (M), Arthur W. Kuhn (M).

Canadian Section

Robert Morrison Aldwinckle (M), Avrom A. Buck (A), John Harold Cane (J), Leslie J. La Douceur (J), Irvin Frederick Musselman (M), William George Richardson (M), William A. Trimble (A).

Central Illinois Section

A. Richard Ayers (M), Lester Lee Pierce (J).

Chicago Section

William H. Beim (A), Donald L. Boyd (J), Charles M. Burlingham, Jr. (J), Robert L. Carlson (J), Laurel E. Carr (M), Devere Carl Dickerson (J), Carl F. Herschbach (M), Harvey P. Ingelse (J), Harry G. Liljeblad (J), William E. Monroe (J), Kenneth G. Rice (J), William H. Thompson (J), Robert Lee Urban (J).

Cincinnati Section

James F. Cox (M), Leonard J. Nowikowski (M).

Cleveland Section

Clifford C. Crabs (J), Harry C. Graham (A), Irwin T. Harris (J), Lyle G. Higgins (A), Henry H. Homitz (M), Thomas W. Lauer (M), John Philip McSweeney (A), William Robert Meyer (J), Thomas R. Stefancin (J), Bertrand R. Warmeling (M).

Colorado Group

Ernest B. Wilson (A).

Dayton Section

R. M. Conklin (M), Salvatore M. Marco (M).

Detroit Section

Walter E. Aring (M), Robert William Beaupre (J), Ralph R. Bekkala (J), Gerald R. Bouwkamp (J), William Joseph Breitenbeck (J), Franklin

Continued on Page 110

New Members Qualified

continued

E. Carr (J), Maurice E. Compton (A), Charles C. Conley (M), Ellard Douglas Davison, Jr. (J), Carl R. Fraser (A), E. W. Gentz (M), Richard E. Halatek (J), C. L. Halpin (M), F. John Herrington, Jr. (J), Kenneth H. Higgins (M), Robert Charles Holan (J), Edward Daniel Klomp (J), Arthur J. Larsen (J), Gordon J. Lawton (M), Thomas A. Loewe (J), Walter R. Mackenzie (M), Wayne A. Martin (M), V. L. McEnally, Jr. (M), Richard D. Moan (J), Hermann D. Mysing (M), Jerald Alvin Outland (J), Wesley R. Parker (J), Jack Jechenik (J), Roland J. Petelka (J), George Romney (M), Edward B. Ryan (M), Richard S. Seeley (J), Nathan Norman Shiovitz (J), Robert B. Singer (J), Daniel H. Spurlin (J), David W. Stapleton (M), William Harold Stark (J), Kenneth A. Stonex (M), Paul W. Stuehn (J), Robert Blair Thornhill (J), Adolf A. Widmann (M).

Hawaii Section

Herbert Gordon Gardiner (M).

Kansas City Section

Jefferson William Baker (J).

Metropolitan Section

Henry Austin Clark, Jr. (A), Elmer T. Davidson (M), Timothy F. Donovan (M), Henry B. Fernald, Jr. (M), Alvin M. Fischer (J), Leonard N. Flomerfelt, Jr. (A), A. Sidney Hanson, Jr. (M), Arthur L. Lawrence (M), J. J. McCarthy (M), Henry J. Sossong (J), Willis H. Taylor (J), Harry D. Weller, Jr. (A).

Mid-Continent Section

Clarence A. Neilson (M), Leon M. Oswalt (M).

Mid-Michigan Section

Donald C. Burnham (M), Arthur W. Corey (M), Jack L. Gockel (J).

Milwaukee Section

Alfred E. Berg (M), Omar Hansen, Jr. (J), Norman Robert O'Hara (A), Carl Otten Trautmann (J), Paul W. Wahler (M), Gilbert Fred Weissert (J), James R. Wynne (J).

Mohawk-Hudson Group

James G. Kiernan (J).

Montreal Section

Paul Edward Falkner (A), Jean Guy Gadoua (J).

New England Section

Clifton N. Lovenberg (M), Monroe A. Maller (M), Charles Robert Plum

New Members Qualified

continued

(M), Walter Hume Renear (A).

Northern California Section

Glen P. McGraw (A), Paul W. Morgan (J), Eugene S. Moulic, Jr. (J), Roy Alfred Renner (J), Dirk Vander-Burch (M).

Northwest Section

Russel S. Adams (J), C. M. Riddell (M), William George Shank (M), Thomas G. Taxelius (J).

Philadelphia Section

Capt. Wellington T. Hines, (M), Edward T. Kennedy (A), LeRoy F. Meredith, Jr. (J), Seymour Wolf Shapiro (J), David W. Shearston (M).

Pittsburgh Section

Arthur Edward Mikoleit (J), Matthew A. Opeka (J), Louis Eugene Pourron, Jr. (J).

Southern California Section

George O. Abell (A), James Clifton Glass (M), Elmer Frederick Hartley (J), Walter F. Keller (J), Kilbourne H. Knox (M), Leonard W. Lewandowski (M), Richard Kenneth Mallis (J), John Andrew McAnulty (M), George S. Schatzman (J), Herman James Schneider (M), Morton H. Wolk (M).

Southern New England Section

Jack M. Cherne (M), Maurice Godet (J).

Spokane Intermountain Section

Charles Elbert Webb (A).

Texas Section

Otto A. Dworak (A), Herbert M. Gaebe (M), Henry C. Jones (A), Victor C. Kobold (J).

Texas Gulf Coast Section

H. Joseph Chase (M).

Twin City Section

Marvin A. Henrickson (M), Hardy G. Reynolds, Jr. (A).

Wichita Section

Donald L. Whitney (J).

Outside Section Territory

Raman Dahyabhai Amin (J), Joyce S. Bailey (A), Robert W. Giertz (J), William Rudolph Hellner (J), Jeremie Joseph Kaelin (M), Don W. Morrison (J), Robert R. Olson (J).

Foreign

Richard I. Emori (J), Japan; Thomas Bruce McSweeney (J), New Zealand; Heinz O. Voigt (M), Saudi-Arabia.

Applications Received

The applications for membership received between Nov. 10, 1953 and Dec. 10, 1953 are listed below.

Atlanta Group

William McIvor Law, Holton Robert Parris.

Baltimore Section

Glenn A. Evans.

British Columbia Section

Donald Andrew Duguid, George Frederick Fuller, William John Mackintosh, Allen Whitfield Tough.

Buffalo Section

Dudley Ogilvie Losee, Harold E. Wells.

Canadian Section

Marcel L. Brier, Elbert L. Buell, Howard A. Freestone, Cornelius Joseph Meredith, Isaac A. Usher.

Central Illinois Section

Roger David Hiserote.

Chicago Section

Bertram E. Corning, William H. Lynch, Dwight L. Mink, Paul G. Moyer, Walter J. Oliver, Joseph C. Saporito, E. Verne Sprunger.

Cleveland Section

Einar A. Borch, Barry Evans, Joseph C. Lash, Paul E. Moore, John G. Russell, Milton R. Vipond, Norman C. Wintle.

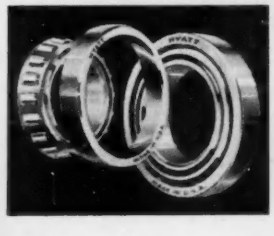
Dayton Section

John I. Covert, James C. Cox, Gerald B. Jacoby, Harold W. Schultz, Russell F. Van Horn, George Walther, Jr., Carl E. Wilkens.

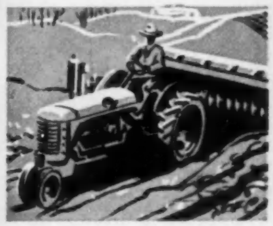
Detroit Section

Jerry Ahlman, Arthur Bartlewski, John J. Bartos, Jackson Beattie, Bertil G. Bergstrom, George S. Bidigare, Kenneth John Biel, Robert H. Birney, Tom Bradley, L. Earle Bretz, Jr., George A. Brundrett, Marion George Brush, A. M. Carlsen, Jr., Clinton F. Chase, Willis M. Clark, Jr., Robert

Continued on Page 114



For tractors and implements . . .



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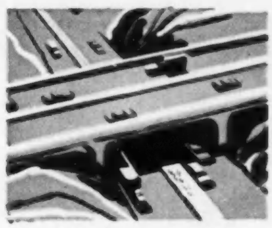

for construction equipment and many types of new machinery.

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STRAIGHT · BARREL · TAPER

HYATT BEARINGS DIVISION • GENERAL MOTORS CORPORATION • HARRISON, N. J.

Applications Received

continued

Anthony Cocozella, Frederick A. Creswick, Walter T. Czuba, Roland S. Domber, William James Dyke, Preston J. Forrest, James C. Gagliardi, William Y. Gard, Gay K. Hall, Luther H. Hicks, Clinton W. Hill, Joseph J. Hill, Boyd E. Horne, Edgar Smith Hughes, John O. Hunter, Ralph R. Johnson, Jr., J. J. Kish, William E. Kracht, Roland G. Krupp, Donald H. Lambert, A. J. Leckie, Jr., Nankert Clarence Leppanen, A. R. Lewellen, III, Ludwik Marceli Liszkiewicz, J. M. R. Lyeth, Jr., Frank C. Meer, Paul G. Milanowski, Joseph T. Neill, Gerald E. O'Loughlin, Dale J. Pierce, Robert G. Renius, James H. Rogers, James P. Schloff, N. Alvin Shealy, Gordon E. Stauffer, Donald E. Stueber, Richard John Tabin, Elmer F. Trarbach, Robert H. Wells, George O. Wickenden, Dean A. Willoughby, Frank J. Winchell, John E. Wion, Carl H. Wolcott, William John Zechel.

Hawaii Section

Edward Y. F. Liu.

Indiana Section

George A. Bretzlaff, Donald P. Driftmier, R. T. Rudolphson.

Kansas City Section

Charles R. Campbell, Robert P. Witschen.

Metropolitan Section

A. J. Bette, A. H. Boultbee, William H. Dietz, Bernard G. Drummond, Howard L. Eckstein, Thomas T. Harrow, Jr., Daniel L. Hertz, Norman W. Hibbard, Thomas W. Johnson, Thomas W. Lippert, John A. Mathe, Leonard E. Moody, Stanley Osladil, Martin L. Razus, T. M. Sullivan, Alexander E. Walordy, Elmer E. Waters, David Wolkov, Frank Lowell Zeek.

Mid-Michigan Section

Dwight H. Buell, Robert John Carroll, Roger L. Daniels, Sinclair L. Edwards, Donald C. Gilbert, Frank R. Kuzner, Kenneth J. Nisper, David F. Page, Douglas M. Patterson.

Milwaukee Section

Erwin Carl Brunke, William J. Dooley, Andrew W. Fulton, Douglas Gordon, Charles H. Heide, Robert Leonard Lawler, Orville William Lemke, D. F. Lucas, Harold M. Nelson, William Donald Nelson, Sylvester J. Schwartz.

Mohawk-Hudson Group

Donald E. Smith.

Montreal Section

George N. Armstrong, Dave Campbell, Chipman H. Drury, George Evans, Charles Henry Grace, John Bain Stirling.

New England Section

Harvey M. Tompkins.

Northern California Section

Charles H. Beckett, John A. Copitzky, Marshall K. Gebert, Kenneth D. Lewis, L. R. Thompson.

Oregon Section

J. A. Gay, William R. Green, Lloyd Hylton.

Philadelphia Section

B. Lewis Hurd, Jr., Howard G. Powell, Robert C. Taylor, Ray L. Wiles.

Applications Received

continued

St. Louis Section

Ben H. Cook, Richard C. Wrausmann.

Salt Lake Group

Leon H. Bates.

Southern California Section

Raymond Charles Buck, Edward Walter Frederick, Jr., Joseph Lotrick, L. R. Miller, James K. Mosher, Mervyn E. Seay, Leo Victor Simon, Gene Soltys, J. Robert Southland, Donald Horigan Stewart.

Spokane-Intermountain Section

Lawrence J. Barker.

Syracuse Section

Clyde H. McMillan, Douglas S. Messenger, Byron C. Motl.

Texas Section

Glenn Martin Jackson, Robert J. Williams, Jr.

Texas Gulf Coast Section

C. V. Bowman, Milton Leonard Silberstein.

Twin City Section

Everitt V. Bersinger, Robert Wade Brautigam.

Washington Section

Jean Arnaud, Henry Linwood Hutchinson, Arthur H. Nuesse, Lt. Comdr. Johan Henri Perie, Daniel J. Siglin, Robert S. Stewart.

Wichita Section

Harold Emmett Rogers.

Outside of Section Territory

Leo Joseph Easterbrook, Jr., Ralph W. Harmon, Porter Landrum, Harvey Arthur Larson, Richard Timon Peterson, Stuart D. Pool, Edwill N. Smith, O. B. Tuggle.

Foreign

Nils Harald Braat, Sweden; Aarno Ekelund, Sweden; Harry Ingham, South Africa; Hans-Eric Lorentz, Sweden; Hans Ulrich Meyer, Switzerland; Pierre Zenon Georges Morand, France; Nicolas C. Nicolas, Egypt; Eric Edward Read, New Zealand.

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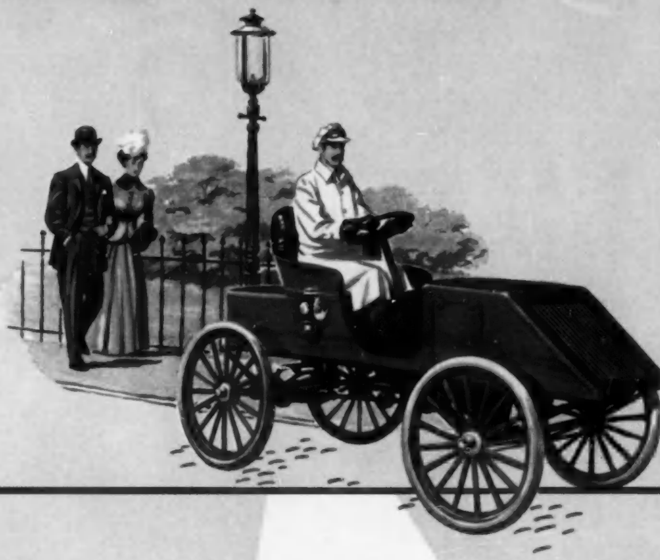

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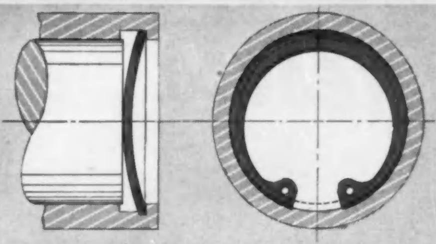
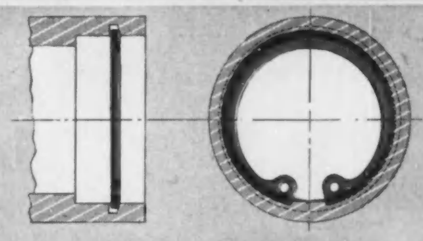
if end-play take-up is a problem one of these special Waldes Truarc rings can solve it



series 5001 · internal type
for bore diameters from: .250 – 1.456 in.



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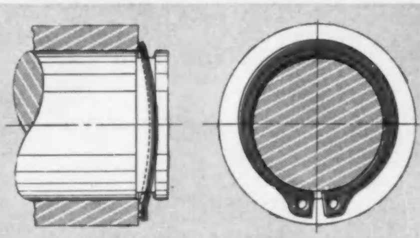
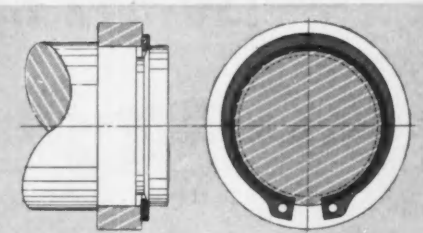


series 5101 · external type
for shaft diameters from: .188 – 1.438 in.



series 5102 · external type
for shaft diameters from: 1 – 10 in.

bowed WALDES TRUARC RETAINING RINGS

Take up end-play resiliently, damp vibrations and oscillations. Bent like a bow out of plane at horizontal center line. The bowed Truarc ring acts in axial direction like a floating spring without losing its tight grip against the bottom of the groove.

Maximum resilient end-play take-up: .015" to .020" depending on size of ring.

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Take up end-play rigidly. When the ring is contracted (or expanded), the tapered edge acts like a wedge moving deeper into the groove and shifting in an axial direction until the ring abuts the machine part.

Maximum end-play take-up, depending on ring size: internal types, .005" to .043"; external types, .005" to .040".

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Waldes Truarc engineers have extended the use of retaining rings by developing rings that perform *additional functions* while acting as retaining shoulders. Those shown here take up end-play, compensate for wear and varying manufacturing tolerances.

No matter what *your* problem, there's a Waldes Truarc Ring designed specifically to solve it. Send us your drawings, your questions—Waldes Truarc engineers will work with you, at no obligation.

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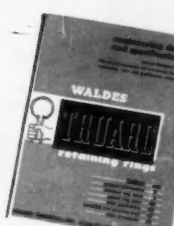

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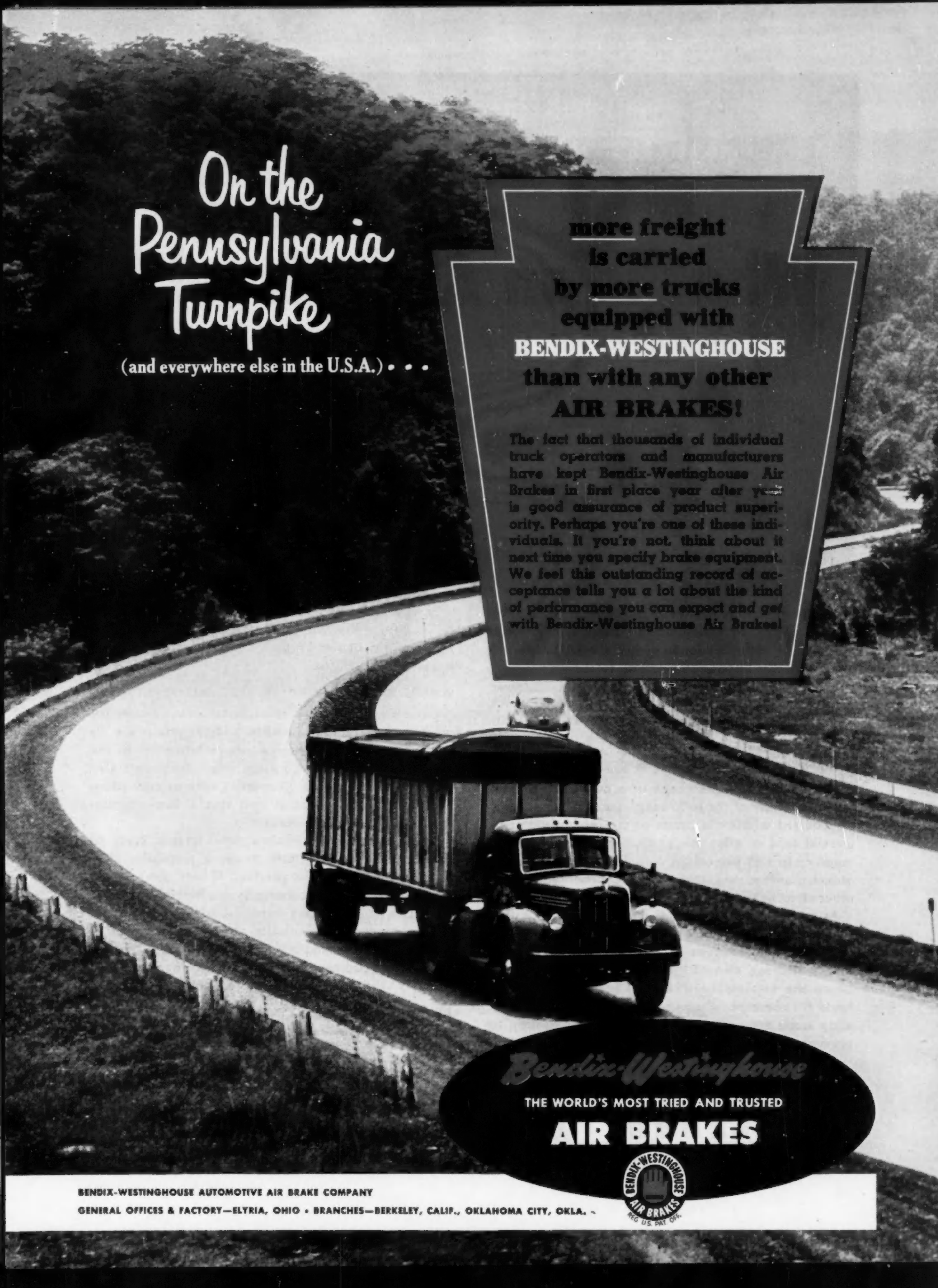
New York • Tulsa • Los Angeles


On the Pennsylvania Turnpike
(and everywhere else in the U.S.A.) . . .
more freight is carried by more trucks equipped with
BENDIX-WESTINGHOUSE
than with any other
AIR BRAKES!
The fact that thousands of individual truck operators and manufacturers have kept Bendix-Westinghouse Air Brakes in first place year after year is good assurance of product superiority. Perhaps you're one of these individuals. It you're not, think about it next time you specify brake equipment. We feel this outstanding record of acceptance tells you a lot about the kind of performance you can expect and get with Bendix-Westinghouse Air Brakes!
Bendix-Westinghouse
THE WORLD'S MOST TRIED AND TRUSTED
AIR BRAKES
BENDIX-WESTINGHOUSE AIR BRAKES
REG. U.S. PAT. OFF.
BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE COMPANY
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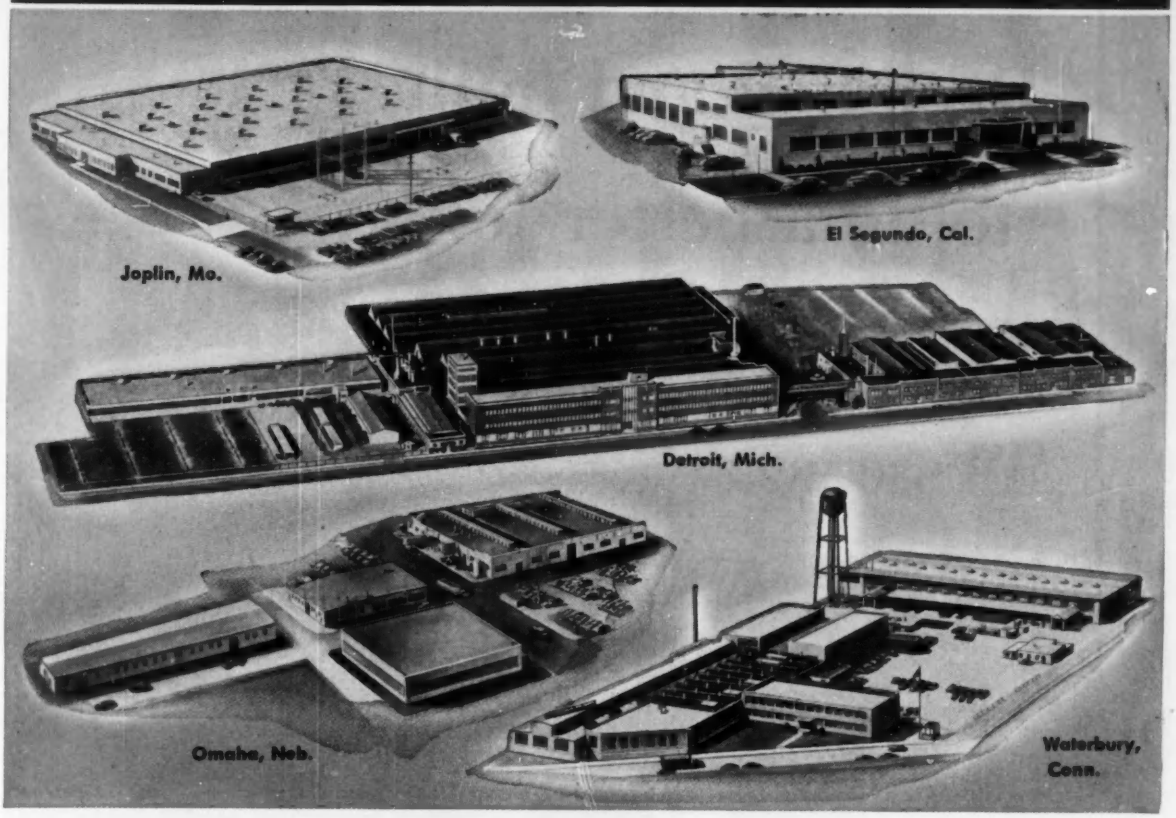
You Get Many Benefits by Specifying VICKERS® Hydraulics



Unmatched Facilities

For Hydraulics Development, Design, Manufacturing and Application

In resources for research, design, development, manufacturing and application, Vickers is unmatched in the hydraulics field. The five plants shown above employ more than six thousand people. These plants are strategically located to best serve the diversified industries that use Vickers Hydraulics.

The large scope of these operations makes it economically practicable for Vickers to develop facilities that would be impossible under other circumstances. As a result, you get more for your money when you buy Vickers Hydraulic Equipment.

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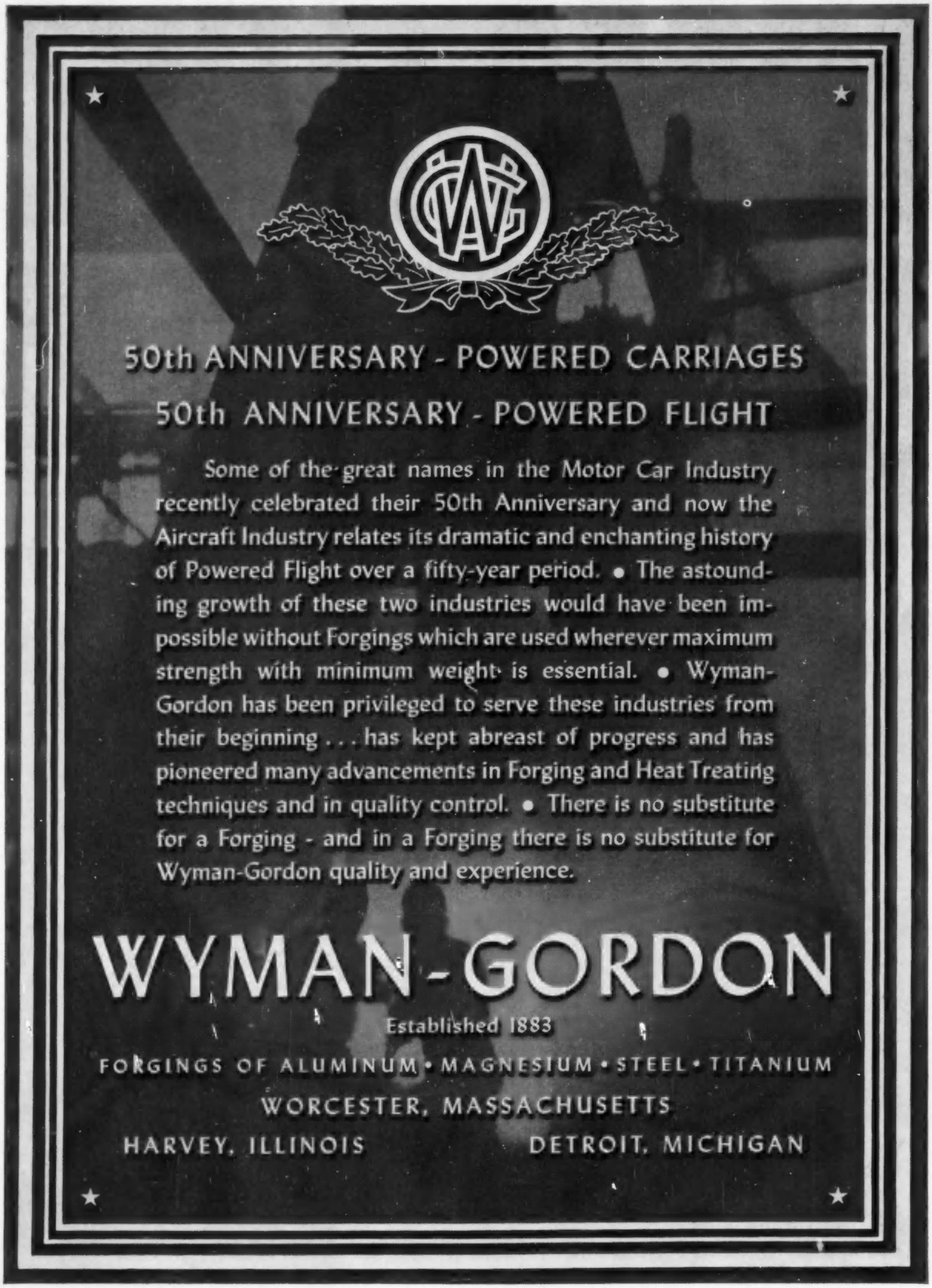
6627

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921


50th ANNIVERSARY - POWERED CARRIAGES
50th ANNIVERSARY - POWERED FLIGHT
Some of the great names in the Motor Car Industry recently celebrated their 50th Anniversary and now the Aircraft Industry relates its dramatic and enchanting history of Powered Flight over a fifty-year period. • The astounding growth of these two industries would have been impossible without Forgings which are used wherever maximum strength with minimum weight is essential. • Wyman-Gordon has been privileged to serve these industries from their beginning . . . has kept abreast of progress and has pioneered many advancements in Forging and Heat Treating techniques and in quality control. • There is no substitute for a Forging - and in a Forging there is no substitute for Wyman-Gordon quality and experience.
WYMAN-GORDON
Established 1883
FORGINGS OF ALUMINUM • MAGNESIUM • STEEL • TITANIUM
WORCESTER, MASSACHUSETTS
HARVEY, ILLINOIS
DETROIT, MICHIGAN


Everyone...but Everyone...
interested in ALUMINUM FINISHES BRAZING ALUMINUM DIE CAST CLUTCH HOUSINGS
. . . is planning a visit to Alcoa's exhibit during the SAE Show. In addition to these things, you'll see the latest on aluminum wheels, radiator materials, automotive wiring, plaster castings and pistons. We're bringing samples of cylinder heads and crankcases that are cast in sections and brazed together . . . and other recent developments in aluminum. We're asking you to join us at . . .
Sheraton-Cadillac Hotel
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ALUMINUM COMPANY OF AMERICA
Alcoa brings the world to your armchair with "See It Now" featuring Edward R. Murrow, Tuesday evenings on most CBS-TV stations.

insure faster starting... peak engine operation without lengthy warm-up!

South Wind's

Model 939-A24

COOLANT HEATER

delivers 15,000 btu/hr. to coolant!

Here is a coolant heater that gives you all the advantages of "inside-out" heating, that offers rapid engine and battery warm-up, that will maintain normal engine temperature on a moving vehicle. These functions insure faster starts, less engine wear, and longer battery life. Here is a coolant heater that is:

COMPACT—approximately 6 inches in diameter, and 15¼ inches long.

POWERFUL—delivers 15,000 BTU/hr. to coolant, with approximately 6,000 BTU/hr. of hot air available for other uses.

SIMPLE—coolant intake and outlet on heater connect directly to cooling system. Coolant may be circulated either by thermosyphon action, or by electric water pump.

JUST CHECK THESE MAJOR FEATURES!

1. Will maintain a specified coolant temperature by cycling automatically between high and low heat.

2. Can provide intermittent or constant heat to battery.

3. Will operate satisfactorily on a moving vehicle.

4. Will withstand exhaust restriction equivalent to more than 125 feet of 1½ inch exhaust pipe.

5. May be mounted horizontally or vertically.

6. Easy installation as a result of package design incorporating self-contained fuel valve, cycling switch, and overheat switch.

7. Specially designed combustion chamber to prevent formation of carbon on water jacket walls.

8. Combustion blower fan powered by reliable ball bearing motor.

9. Unit radio suppressed to latest requirements of MIL-S-10379.

10. Unique design allows for low production cost.

11. Service parts interchangeable with those of South Wind Model 978 personnel heater.

Do You Have a Heating Problem? Write today for the experienced counsel of South Wind field engineers about *any* problem in pre-heating. The wide range of South Wind Heaters includes 15,000 – 20,000 – 30,000 – 50,000 – 60,000 – 100,000 – 200,000 – 600,000 – and 700,000 BTU/hr. capacities. Write South Wind Division, Stewart-Warner Corporation, Indianapolis 7, Indiana.

South Wind
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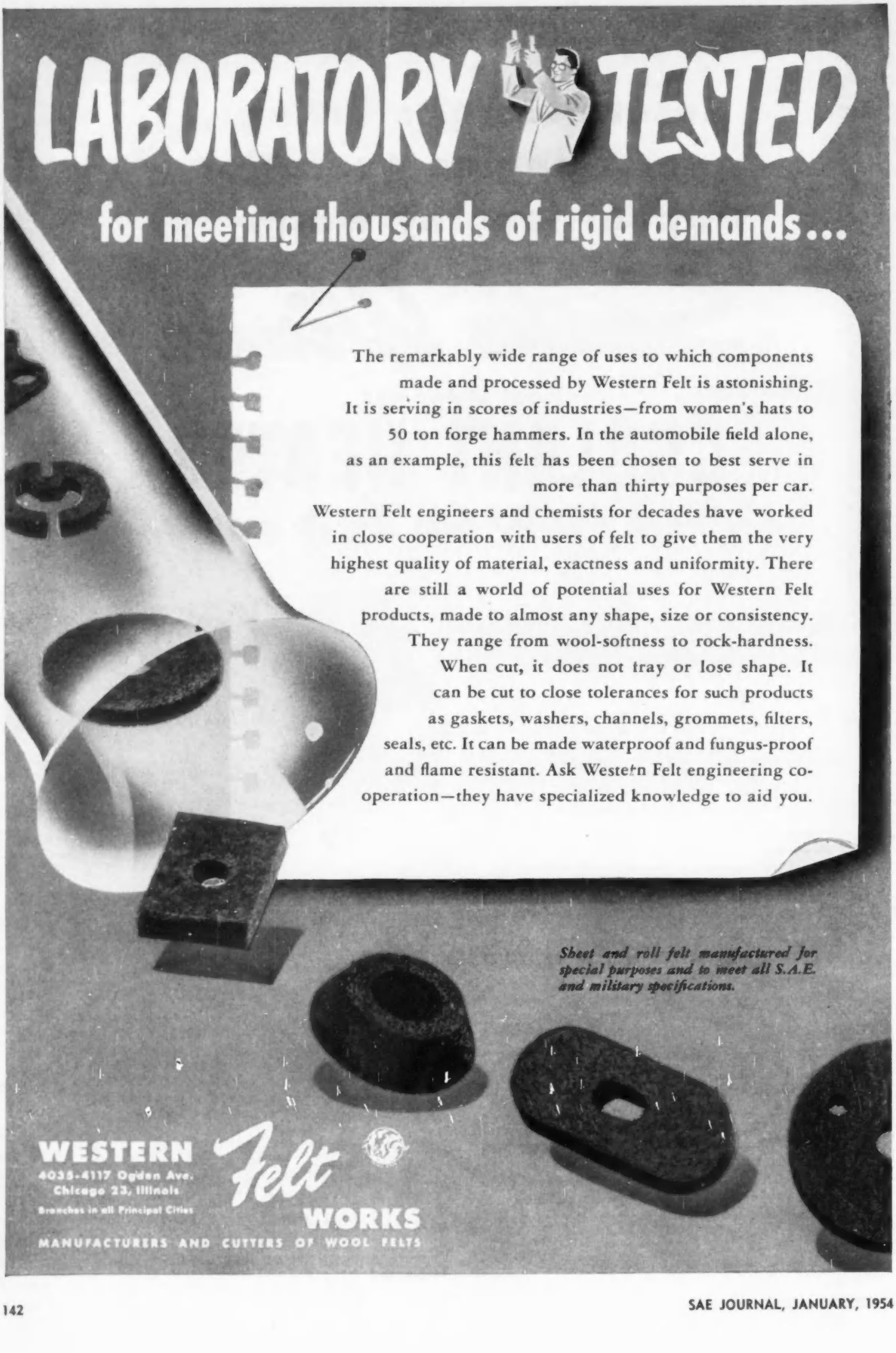
A PRODUCT OF SW STEWART WARNER

PERSONNEL HEATING
ENGINE AND EQUIPMENT PRE-HEATING
WINDSHIELD DEFROSTING


LABORATORY TESTED
for meeting thousands of rigid demands...
The remarkably wide range of uses to which components made and processed by Western Felt is astonishing. It is serving in scores of industries—from women's hats to 50 ton forge hammers. In the automobile field alone, as an example, this felt has been chosen to best serve in more than thirty purposes per car. Western Felt engineers and chemists for decades have worked in close cooperation with users of felt to give them the very highest quality of material, exactness and uniformity. There are still a world of potential uses for Western Felt products, made to almost any shape, size or consistency. They range from wool-softness to rock-hardness. When cut, it does not fray or lose shape. It can be cut to close tolerances for such products as gaskets, washers, channels, grommets, filters, seals, etc. It can be made waterproof and fungus-proof and flame resistant. Ask Western Felt engineering co-operation—they have specialized knowledge to aid you.
Sheet and roll felt manufactured for special purposes and to meet all S.A.E. and military specifications.
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MANUFACTURERS AND CUTTERS OF WOOL FELTS

No. 28430

control *is the vital element*

Recognizing that in the operation of any airplane or helicopter "Control is the Vital Element," ADEL has centered its design and fabrication around this all-important factor.

As manufacturers of Aircraft Hydraulic and Pneumatic Control Equipment, Heater, Anti-Icing and Fuel System Equipment and Engine Accessories, ADEL is helping to make the aircraft of American manufacturers safer, more dependable and more efficient under any and all conditions.

ADEL ***equipment is first choice in the aircraft industry.***

High pressure, motor driven hydraulic pump for a current aircraft application. Requires 25% less amperage and effects a weight reduction of over 30%. Another aircraft accessory providing better performance when completely engineered by ADEL.

*Patent Pending

A DIVISION OF GENERAL METALS CORPORATION
Burbank, California • Huntington, West Virginia
CANADA: Railway & Power Engineering Corporation, Limited

ADEL

Here is the

PARKER LINE

metal surface treatments that aid production, improve product quality, enhance appearance and durability...

BONDERITE

corrosion resistant paint base

This well-known product is used to prepare metal for fine baked paint finishes on thousands of products. Automobiles, trucks, refrigerators, domestic appliances of all kinds, control boxes, metal furniture, office partitions, transformers, and toys are a few of the types of products on which Bonderite is used.

Applied by either spray or immersion, Bonderite creates a nonmetallic phosphate coating over the entire surface. This coating is integral with the metal surface, forming an effective barrier against the penetration of moisture, and furnishing an excellent base for paint.

Bonderite produces dependable results of uniformly high quality, is easily controlled and economical in operation. It may be used to treat steel, aluminum, zinc, and cadmium.

Bonderite adds durability and appearance protection to painted metal by combating corrosion and anchoring the paint securely.

PARCO COMPOUND

rust resistant

This is the standard corrosion protection for iron and steel.

Iron and steel parts to be treated are immersed in Parco Compound solution, which creates a nonmetallic crystalline phosphate coating over all the surfaces of the metal. Complex shapes of all sizes from steel boat plates down to nuts, bolts and screws are treated with Parco Compound. Treatment is simple, controls are easily maintained, and cost is extremely low.

BONDERITE and BONDERLUBE

aids in cold forming of metals

These two Parker products are a big factor in accomplishing the present revolution in cold forming techniques. Nonmetallic Bonderite, used in tube mills for many years to hold lubricant, protect dies from excessive wear, and allow greater reductions—combines with the amazingly effective Bonderlubes to transform problem draws and extrusions into production routine.

The combination of Bonderite and Bonderlube is used extensively in the manufacture of shells and cartridge cases, shafts, gears and pins, making important savings in time, money, and material.

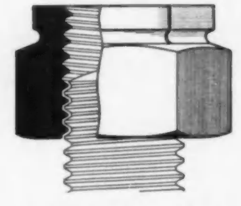
kitchen worksavers *with a built-in shine!*

Manufacturers of couplings like these find that FLEXLOC Self-Locking Nuts provide faster assembly and safer, more dependable locking than is afforded by most other methods.

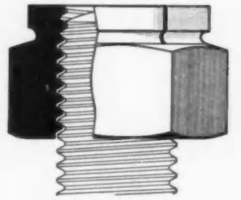
Here's why more and more original equipment manufacturers specify FLEXLOCs

Whether it's on power transmission couplings or on access doors of helicopters, more and more FLEXLOC Self-Locking Nuts are being used to insure positive fastening of assemblies.

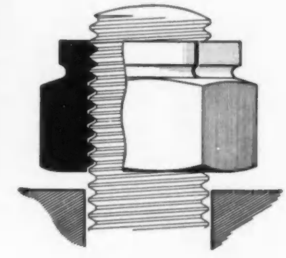
There are many reasons for this. FLEXLOCs reduce production costs. They are easy to install. They are one piece, all metal—nothing to assemble, come apart, lose or forget. They eliminate complicated, time-consuming methods of locking bolts and studs. They stay put—once their locking threads are fully engaged, they won't work loose. They are easy to get—SPS can make prompt delivery of FLEXLOCs in any quantity, and in a wide range of sizes, through a national organization of industrial distributors. Write for literature and samples. STANDARD PRESSED STEEL CO., Jenkintown 55, Pa.



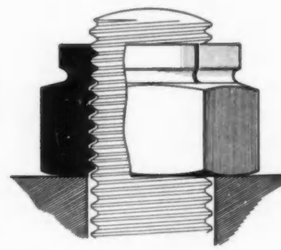
Starting. A FLEXLOC starts like any ordinary nut. Put it on with your fingers. Tighten it with a standard hand or speed wrench.



Beginning to Lock. As the bolt enters the segmented locking section, the section is expanded, and the nut starts to lock.



Fully Locked As a Stop Nut. When 1½ threads of a standard bolt are past the top of the nut, the FLEXLOC is fully locked. A FLEXLOC does not have to seat to lock.



Fully Locked As a Seated Nut. When it is used as a lock or stop nut, the locking threads of the FLEXLOC press inward against the bolt, lifting the nut upward and causing the remaining threads to bear against the lower surface of the bolt threads. Vibration will not loosen a FLEXLOC, yet there is no galling of threads.

FLEXLOC® LOCKNUT DIVISION

SPS
JENKINTOWN PENNSYLVANIA


PAVEMENT
ENDS
Proceed with
maximum comfort on
DELCO
SHOCK ABSORBERS
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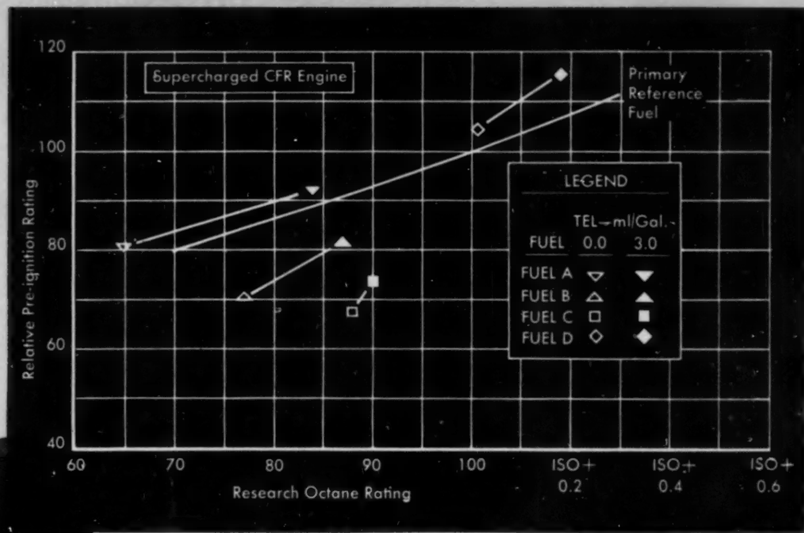

Du Pont research shows:

THIS CHART SHOWS the increased resistance to *both* knock and pre-ignition due to the addition of tetraethyl lead in several fuels.

Tetraethyl lead can be effectively used to reduce PRE-IGNITION complaints in automotive engines

Progress in automotive engineering toward higher compression engines has been rapid.

However, some of these advanced engines are highly sensitive to pre-ignition—generally manifested by loud, erratic noises. And this tendency threatens to limit further improvement in the efficiency of fuel utilization in gasoline engines.

In an effort to help petroleum refiners and automotive engineers overcome this problem, the Du Pont Petroleum Laboratory is conducting extensive basic research on pre-ignition. A solution to the problem has been sought by:

1. Reducing the tendencies of combustion chamber deposits to glow and cause surface ignition of the charge.
2. Improving the ability of fuels to withstand ignition by hot surfaces.

It has been found that certain additives reduce deposit glow and offer a solution to the problem.

However, as engine compression ratios are increased still further, it may also be necessary to increase the pre-ignition resistance of the fuels themselves.

Effect of tetraethyl lead—Some hydrocarbons are more sensitive than others to ignition by glowing deposit particles. Preflame reactions tend to sensitize the fuels to ignition by these glowing deposit particles.

The effect of these preflame reactions can usually be minimized by tetraethyl lead—thus increasing the pre-ignition resistance of the gasoline.

More details available—This research on pre-ignition is part of a continuing program by the Du Pont Petroleum Laboratory. More complete details on these investigations can be obtained from any Du Pont Petroleum Chemicals Division district office listed below. Ask for papers entitled "Pre-Ignition in Automotive Engines" and "An Investigation of Pre-Ignition in Engines."

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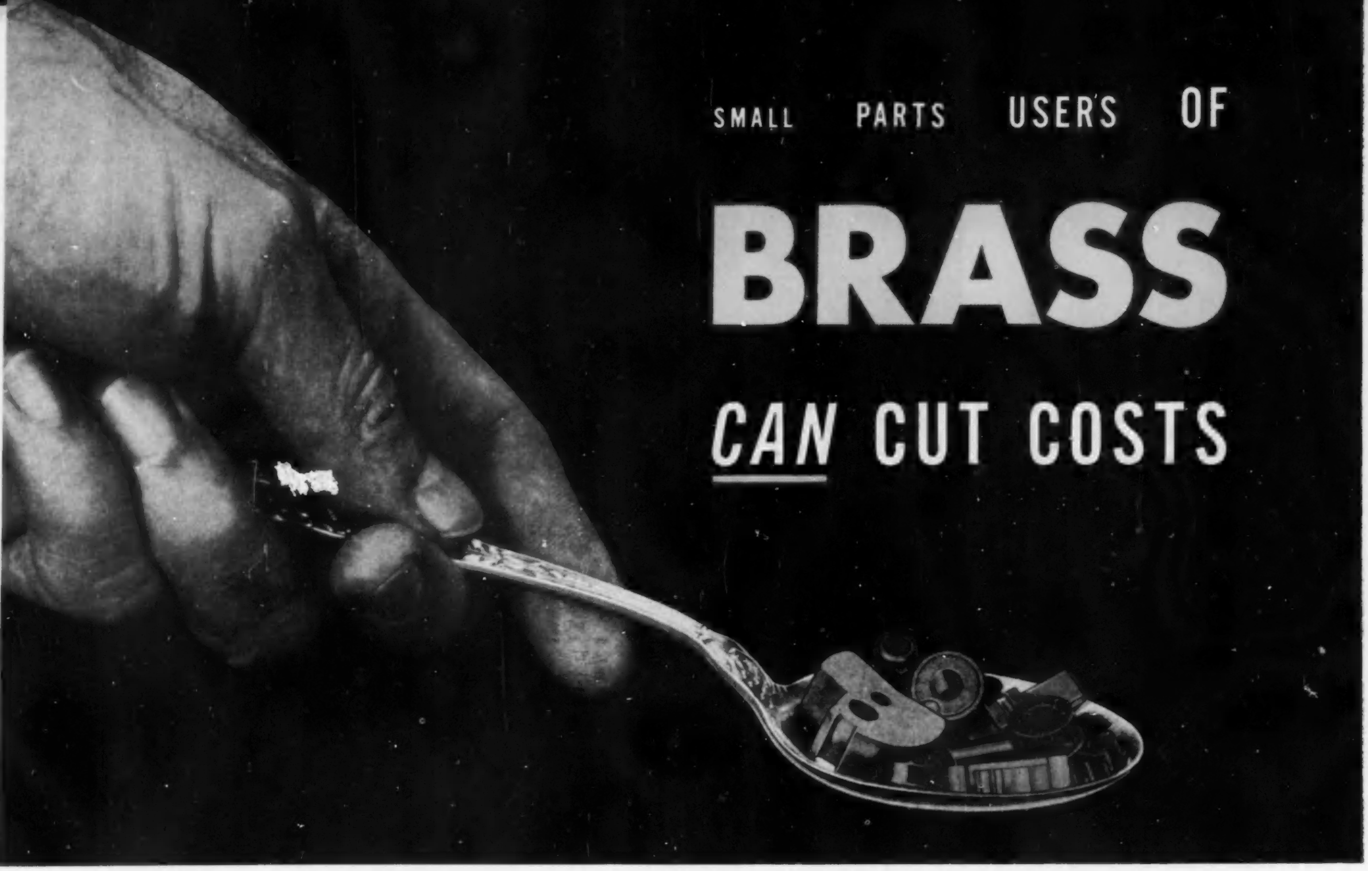


BY DESIGNING PARTS TO BE *PRESSED FROM BRASS POWDER*

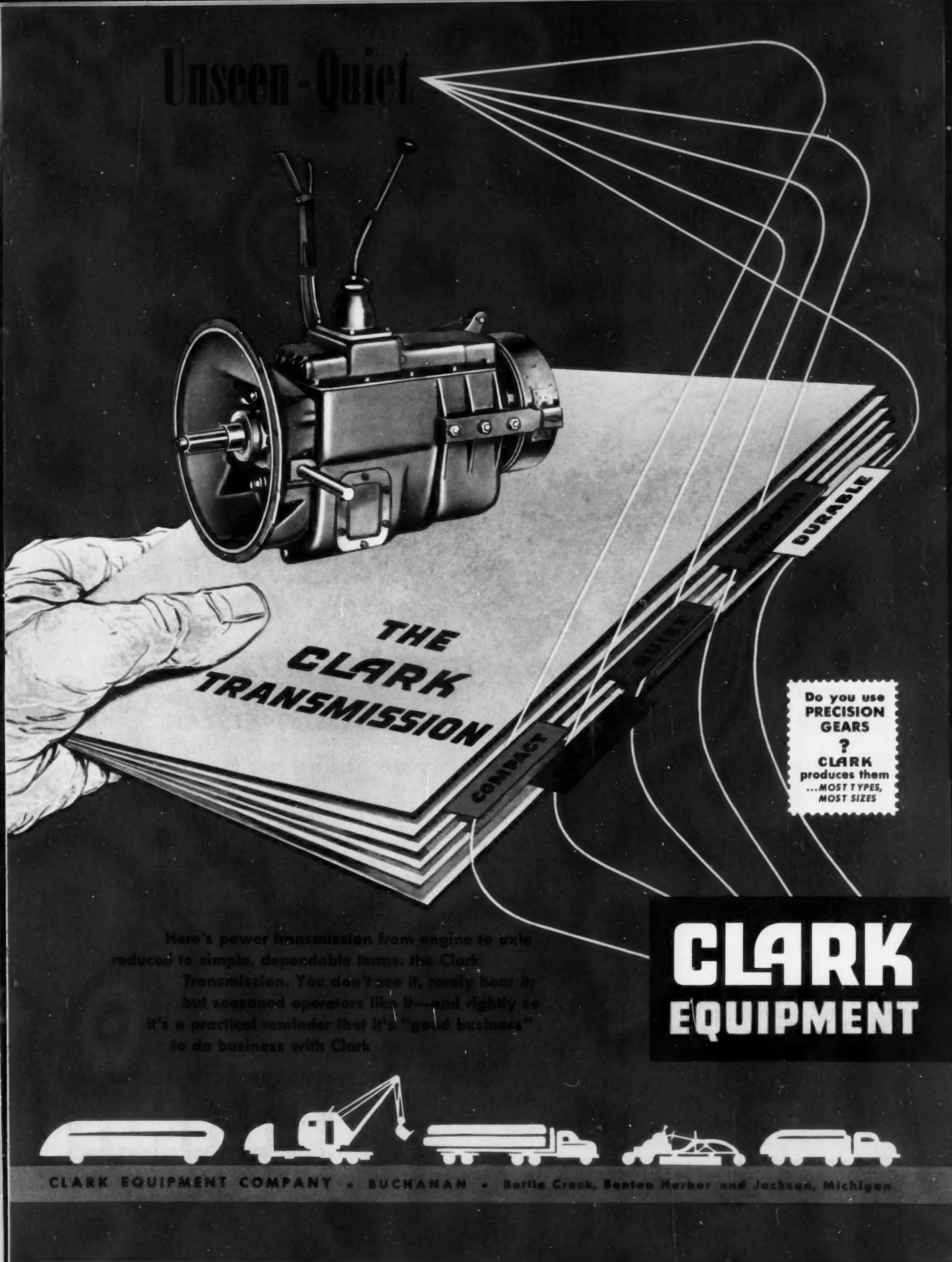
The tens of millions of powder metallurgy brass parts in use today are evidence that alert engineers can design this proven material into many products which previously called for a brass casting, stamping, or machined part. In designing parts of brass—as in any other design problem—price is rarely the first factor to consider—but almost always the *second.* It's QUALITY you consider first. Will the part meet your requirements for strength, density, color, accuracy of size . . . meet these requirements uniformly by the tens of thousands or by the millions? Bound Brook, pioneer in powder metallurgy can answer your quality questions . . . then, if your requirements are for volume . . . can usually quote a price that means a substantial saving . . . and can make delivery, as promised, to keep your production line moving. For authoritative answers on your questions about powdered brass, bronze, or iron parts . . . or bronze or iron bearings . . . write or wire Bound Brook direct or telephone your nearby Bound Brook man.

BOUND BROOK

BOUND BROOK OIL-LESS BEARING CO., EST. 1883, BOUND BROOK, N. J.

Pioneer in

POWDER METALLURGY BEARINGS + PARTS



Unseen - Quiet
THE CLARK TRANSMISSION
COMPACT
QUIET
SMOOTH
DURABLE
Do you use PRECISION GEARS ?
CLARK produces them
...MOST TYPES, MOST SIZES
Here's power transmission from engine to axle reduced to simple, dependable terms: the Clark Transmission. You don't see it, rarely hear it; but seasoned operators like it—and rightly so . . . it's a practical reminder that it's "good business" to do business with Clark
CLARK EQUIPMENT
CLARK EQUIPMENT COMPANY • BUCHANAN • Battle Creek, Benton Harbor and Jackson, Michigan

"Here's why we swear by Clark fork trucks—we handle 50% more volume with half as much effort"

EDWIN L. BURT, GENERAL MANAGER, RESERVE SUPPLY CORP., FRANKLIN PARK, ILL.

Insofar as possible, by prearrangement with suppliers, all shipments to Reserve Supply, building material concern dealing with about 300 customers, come in unit loads on pallets. Upon arrival, two Clark Carloaders (4000 lb. gas-powered fork trucks) unload the cars; warehouse the material—tiering as high as 16 feet; and withdraw customer's orders—usually handling the palletized unit loads directly into customers' trucks. Materials consist of building board, insulation, masonite, rock lath, tile and many other items—no lumber.

"A carload of insulation-board sheeting (60,000 square feet)" says Mr. Burt, "is unloaded by one man on a Clark fork truck in just one hour—in contrast to 33 man-hours required to do the job by hand. In our old warehouse, some two years ago, 13 of our men were involved in materials handling—no trucks; in our new warehouse, six men and the two Clarks handle a 50% greater volume. We are exceedingly pleased with our Clark machines."

Nothing here, you may say, that can't be done in your business—and you're probably right.

Good way to investigate is to ask the nearby Clark dealer, a fully qualified consultant on planning a materials handling system to meet your own specific needs. Call him—he's listed in the Yellow Pages of your phone book.

Industrial Truck Division
CLARK EQUIPMENT COMPANY
BATTLE CREEK, MICHIGAN

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PRODUCTS OF CLARK—TRANSMISSIONS • AXLE HOUSINGS • TRACTOR UNITS FORK TRUCKS and TOWING TRACTORS • ROSS CARRIERS • POWRWORKER HAND TRUCKS • POWER SHOVELS • ELECTRIC STEEL CASTINGS • GEARS and FORGINGS • FRONT and REAR AXLES for TRUCKS and BUSES

High Strength Nickel Alloyed Steels give greater play to the skill of the automotive engineer, because these nickel-containing steels have greater stamina and toughness as well as resistance to wear, shock, fatigue and corrosion. Send us details of your metal problems for our suggestions.

Black Diamond

cuts deadweight . . . adds load capacity

"We manufacture the lightest steel trailer ever built" . . . states the Black Diamond Trailer Company, Inc. of Bristol, Va.

Weight reduction obviously brings basic advantages to trailer users, because less deadweight allows greater payload and, correspondingly, an increase in revenue. Secondary advantages are that every pound trimmed off saves fuel and reduces wear on tires and brakes. As a result, operating costs go down.

To reduce weight without sacrificing safety, Black Diamond uses thin, light sections of high strength, low alloy steel containing nickel.

Nickel alloyed steels of this type provide the same strength as thicker, heavier sections of plain carbon steel. Compared to carbon steels adjusted to provide equal tensile strength, the nickel alloyed steels show superior behavior in fabrication, including welding and cold-forming.

In addition, these nickel alloyed steels resist abrasion and erosion as well as many types of corrosion, and thus lengthen equipment life substantially. Produced under various trade names by leading steel companies, these high strength steels containing nickel along with other alloying elements, provide three basic advantages:

1. High strength, in the as-rolled condition, permitting important weight reductions.

2. Excellent response to usual fabrication operations, including easy forming and welding.

3. Good resistance to corrosion, abrasion and impact.

Consult us on the use of these high strength, nickel alloy steels in your products or equipment. Write us, today.

INCO

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

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governors *by the thousands*

. . . are in daily use for accurate, dependable engine speed control wherever wheels turn . . . the result of more than 40 years specialization in the speed-control field. More than 4,000 different governor assemblies have been designed and built by Pierce to meet exacting problems and applications encountered by engine builders. Pierce Governors are standard equipment on America's finest engines. We can supply *you* with the governor you need for *your* engine or engine-powered equipment.

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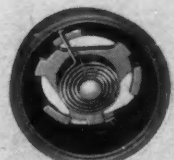
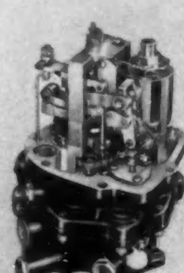
Your problem interests us. We'd like to work with you on the engine controls you need . . . carburetor choking, constant speed control, overspeed protection, overspeed safety cut-off, fuel regulation or related requirements. Tell us your specific problem . . . we'll send a qualified engineer.

Ask for our new brochure—"40 Years of Manufacturing Precision Controls."

also built by **PIERCE...**





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Automatic and Electrimatic carburetor chokes as original equipment or replacement *19 million chokes in the past 17 years!*

Aircraft Accessories . . .
Overspeed governors and fuel controls for America's finest turbojet aircraft engines.

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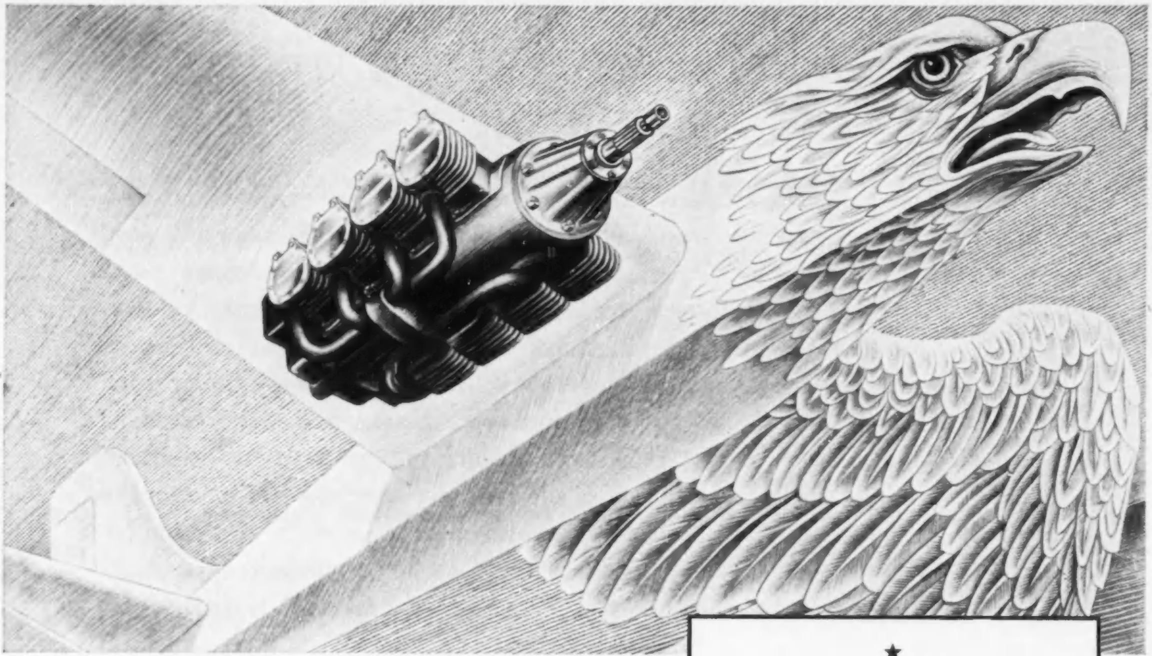

How **Lycoming** helps America grow stronger "wings"

Pioneer in air-cooled engines, Lycoming now makes important contributions to jet progress

Over 25 years ago, Lycoming created its first aircraft engine. Today, Lycoming builds 54 different reciprocating engines with a horsepower range from 65 to 1525—including America's only geared and supercharged air-cooled engines in the 400-h.p. class.

In the field of jet power, Lycoming produces high-quality precision parts and major assemblies. From Lycoming come engine components for J-47 jet engines . . . main leg cylinders for F-86 Sabrejet landing gear . . . complete gearboxes for J-40 jet engines.

Do *you* need dependable air-cooled power . . . precision parts . . . or any other of the diversified services listed with our signature? Lycoming's wealth of creative engineering ability . . . 2½ million square feet of floor space . . . and 6,000-plus machine tools stand ready to serve you. *Whatever* your problem . . . *look to Lycoming!*

★

LOOK AT AMERICA'S LEADERS WHO LOOK TO LYCOMING

★

AERO DESIGN AND ENGINEERING COMPANY
AMERICAN CAR AND FOUNDRY COMPANY
AIR MATERIEL COMMAND
BEECH AIRCRAFT CORPORATION
BENDIX AVIATION CORPORATION
CESSNA AIRCRAFT CORPORATION
THE CLEVELAND PNEUMATIC TOOL COMPANY
DOMAN HELICOPTERS, INC.
FOOD MACHINERY & CHEMICAL CORPORATION
FORD MOTOR COMPANY
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CHEVROLET-AVIATION ENGINE DIVISION
DETROIT TRANSMISSION DIVISION
CADILLAC MOTORCAR DIVISION
INTERNATIONAL BUSINESS MACHINES CORPORATION
KAMAN HELICOPTER CORPORATION
NAVY BUREAU OF AERONAUTICS
NEW IDEA FARM EQUIPMENT COMPANY
PIASECKI HELICOPTER CORPORATION
PIPER AIRCRAFT CORPORATION
PRATT & WHITNEY AIRCRAFT
RYAN AERONAUTICAL CORPORATION
SYLVANIA ELECTRIC PRODUCTS, INC.
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WESTINGHOUSE ELECTRIC CORPORATION
WRIGHT AERONAUTICAL DIVISION
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Just off the press! "THE LYCOMING STORY"... 40 interesting, illustrated pages showing many ways Lycoming is ready to help you. Write for it on your letterhead.

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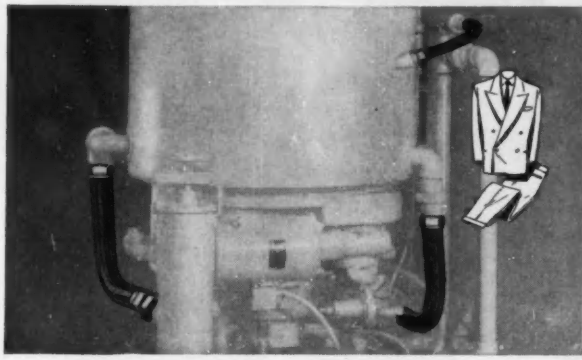
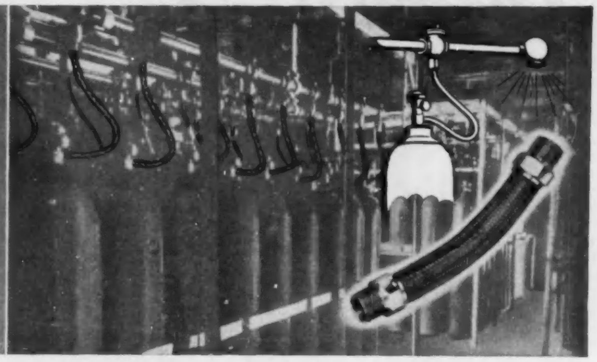
FOR RESEARCH · FOR PRECISION PRODUCTION
LOOK TO **Lycoming**
DIVISION OF AVCO
WILLIAMSPORT, PA. STRATFORD, CONN.

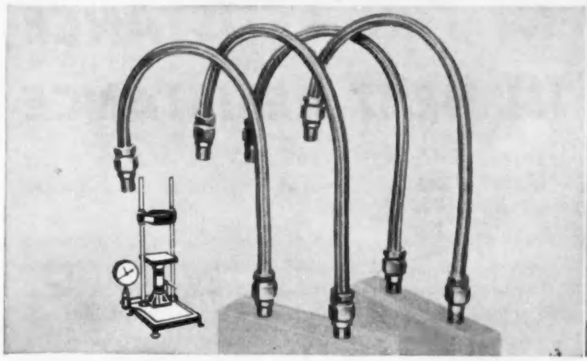
Pick an idea—lick a design problem...



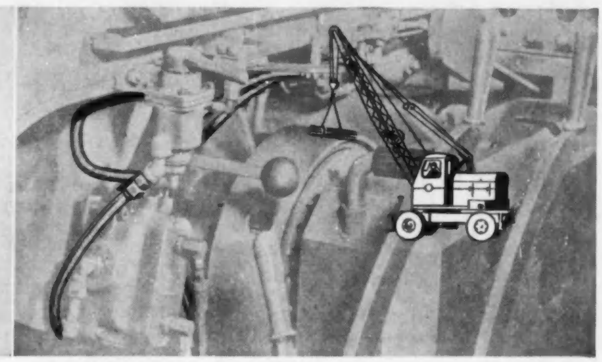
END VIBRATION AND LEAKAGE. Titeflex® metal hose, used as fill and drain lines of SEC Synthetic Cleaning Units, kills vibration and prevents solvent leakage at fittings. Tough, wear-and-corrosion-resistant Titeflex is just as effective in handling steam, oil, lubricants, fuels, gases, brine, acids, compressed air or oxygen. Design and construction of Titeflex assure trouble-free performance. Excellent for projects involving extreme configurations.



CONTROL CRITICAL PRESSURES. How would you connect 280 cylinders of fire-extinguishing carbon dioxide at 850 psi to line? Walter Kidde & Company licked this problem with Titeflex flexible metal hose which met all insurance standards and withstood rigid application requirements. Titeflex also conveys hundreds of different fluids under as many different temperature and pressure conditions. Resists corrosion, vibration, physical abuse.



CONDUCT STEAM SAFELY. Plates for Carver Laboratory Press carry steam up to 200 psi (nearly 400°F.) for heating—water for cooling. The connections are flexible, pressure-safe Titeflex. Braiding gives extra strength. Added problems of vibration, pulsation, continuous movement, corrosion or abrasion make Titeflex invaluable in scores of other applications.



FIGHT FATIGUE AND WEAR. Titeflex metal hose eliminated maintenance on air control lines of Unit Mobile Cranes. All-metal construction, with braiding woven directly upon the hose, provides great strength and resistance to vibration, corrosion, wear and abuse. Flexibility of Titeflex permits simplified assembly even where space configurations are problems.

THE USES FOR TITEFLEX® seamed flexible metal hose and Uniflex seamless flexible metal hose are limited only by engineering ingenuity. And Titeflex design engineers—working *with* customers—develop new applications daily. Somewhere in your plant or on your products Titeflex can improve operation and maintenance—or simplify a design problem. Our *new 48-page Metal Hose Catalog* No. 200 shows you how and why. To get your free copy, simply mail the coupon.

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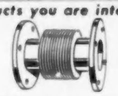
Titeflex

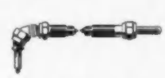
✓ *Check products you are interested in.*

☐ SEAMED AND SEAMLESS METAL HOSE

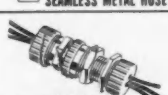


☐ PRECISION BELLOWS

☐ IGNITION HARNESS



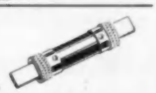
☐ IGNITION SHIELDING



☐ ELECTRICAL CONNECTORS

☐ RIGID AND FLEXIBLE WAVE GUIDES

☐ WIRING SYSTEMS



☐ FUSES

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NOW . . . get PERMANENT FIRE RESISTANCE WITH NO LOSS IN HEAT RESISTANCE

TYPICAL PROPERTIES

- Weight loss of castings:
  After 168 hrs. at 392°F 2-3%
  After 720 hrs. at 392°F ... 13-15%
- Flexural strength retention of glass cloth laminates:
  After 168 hrs. at 392°F .. up to 90%
  After 720 hrs. water immersion 92%
- Shrinkage during curing........5%
- ASTM heat distortion point of castings .... 212-220°F
- Electrical properties of castings at 10^9 cycles:
  Dielectric constant 2.85
  Power factor .... .00575
  Loss factor .... .0164

FOR COMPLETE INFORMATION on HETRON resins, send today for technical data sheets listing properties of the liquid resins, cured unfilled resins, and glass cloth laminates. Includes general handling and curing recommendations, and other useful information.

In HETRON, a new family of self-extinguishing resins, you will find *in full measure* all the properties a good fire-resistant polyester should have.

Heat resistance, in particular, is outstanding. Castings aged at 200°C lost only 2% of weight in seven days (as compared with 10% or more for standard non-fire-resistant resins, and up to 20% for ordinary fire-resistant resins).

Glass cloth laminates aged at 200°C for seven days retained up to 90% of their room temperature flexural strength. Fire resistance was virtually unchanged in the same period.

HETRON resins are self-extinguishing even without the use of additives, because they contain 30% chemically-bound chlorine. At the same time, they are clear and stable. Where even higher fire resistance is desired, addition of 5% antimony trioxide results in laminates that will not support a flame for one second, even after five repeated applications of a Bunsen flame.

Transmission of water vapor through HETRON resins is very low, compared to standard resins—so low that it is difficult to measure accurately. Absorption of water is also lower. For these reasons, electrical properties of the resins are much less affected by long exposure to high humidities and elevated temperatures than ordinary polyesters.

Shrinkage-on-cure of less than 5% by volume, and little or no air inhibition, are important advantages of the new resins. Resistance to acids is better than that of standard resins. Heat distortion temperatures are better than with many standard polyesters.

HETRON resins are light-colored, transparent viscous liquids. At present, they are available in drum quantities.

The facilities of our laboratories are available to cooperate with you in the application of HETRON polyester resins.

From the Salt of the Earth

HOOKER CHEMICALS

3-1960

HOOKER ELECTROCHEMICAL COMPANY

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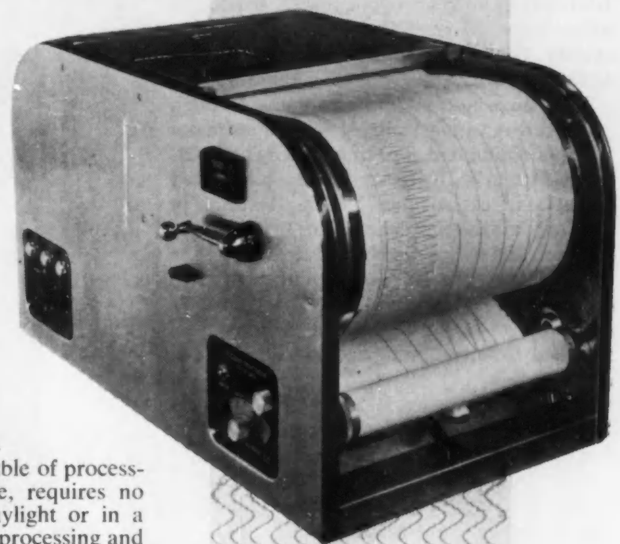
NIAGARA FALLS • TACOMA • MONTAGUE, MICH. • NEW YORK • CHICAGO • LOS ANGELES

New, compact photo-record processor

for paper oscillograms and other rolled paper photo-records



THE TEST ENGINEER'S DILEMMA—how to develop and dry large quantities of test data on rolled sensitized paper—is solved by Consolidated's new Type 23-109 Oscillogram Processor. Built for operation at the actual testing site, this self-contained instrument, capable of processing records as rapidly as 15 feet per minute, requires no external water supply and can be used in daylight or in a normally illuminated room. Simplified loading, processing and unloading techniques permit operation by personnel without previous photo-lab experience. The Type 23-109 processor is compact, portable and fast, requiring only electric power for the paper-transport motor and the drying drum. Where the problem is to save time in processing voluminous test data on photo-record paper, CEC's new oscillogram processor is the practical answer. Write for Bulletin CEC 1537A-X6.

Consolidated Type 23-109

Reduces time lag between test and interpretation of data.

Requires no dark room for operation.

Built for testing-site use without external source of water.

250 foot capacity for photo-record paper up to 12″ widths.

Thermostatically controlled solution temperature.

Automatic squeegeeing for longer solution life.

Cumulative processed-footage indicator.

Loading of the magazine is easy. Processing of paper in varying widths to 12″ is handled by simple, adjustable guides.

Threading the processor is simple. Insertion of the roller racks threads the short leader quickly and easily.

Consolidated Engineering
CORPORATION
300 North Sierra Madre Villa, Pasadena 15, California

Sales and Service through **CEC INSTRUMENTS, INC.,** *a subsidiary with offices in: Pasadena, New York, Chicago, Washington, D. C., Philadelphia, Dallas.*

ANALYTICAL INSTRUMENTS FOR SCIENCE AND INDUSTRY

Need small bearings that can carry heavy loads?

here's how manufacturers of materials handling equipment get them with NEEDLE BEARINGS

Leading manufacturers of lift trucks, industrial trolleys and conveyors, cranes, hoists and other types of materials handling equipment specify Torrington Needle Bearings because of their high capacity and their compactness.

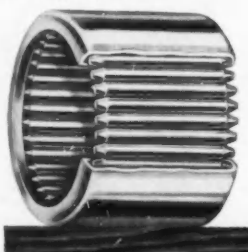
They have been *performance-proved* through years of continuous, rugged service on many types of equipment, working indoors and out.

In lift trucks, for example, the high rated radial load capacity of Needle Bearings in steering knuckles, steering idler arms, transmissions and hydraulic lift cylinder crossheads has made possible increased load ratings without increase in power requirements. And their compactness permits the use of maximum material in surrounding members for added strength.

Torrington Needle Bearings have become "standard equipment" throughout industry since their introduction nearly twenty years ago.

Our Engineering Department will be glad to help you determine where the Needle Bearing can benefit your products.

THE TORRINGTON COMPANY
Torrington, Conn. • South Bend 21, Ind.



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Trade-marks of leading materials handling equipment manufacturers who use Needle Bearings in their products.

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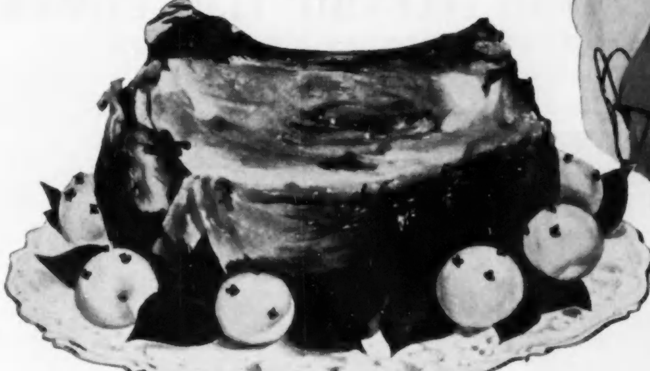
Sure **BEEF STEW** *is good . . .*



But sometimes you want **ROAST BEEF**

IT'S THE SAME WITH STAINLESS STEEL

During the years that chromium-nickel grades of Allegheny Metal were restricted to essential uses under priorities, we made great strides in the development of alternate stainless grades.

These alternate grades are *good,* mind you! In most cases, you'd never know the difference in looks or performance; and in many cases there's little or no difference in fabricating methods, and a possible advantage in cost. Without doubt, they'll continue to be used in hundreds of applications.

But there are other hundreds of uses where only a chromium-nickel grade of Allegheny Metal will do the job *best* . . . because of unusual strength requirements, perhaps—or the need for exceptional corrosion resistance or for non-magnetic properties, special fabricating qualities, etc.

Now that all alloy materials have been freed from controls, we can produce *any* grade of stainless steel you may require; and as always, in any shape or form. ● Give yourself a competitive edge with Allegheny Metal . . . and let us help you determine the grade that exactly fills the bill. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

W&D 4920 B

You can make it BETTER with

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"HYDRAGUIDE" takes the work out of driving — restores the pleasure.
Pioneered by
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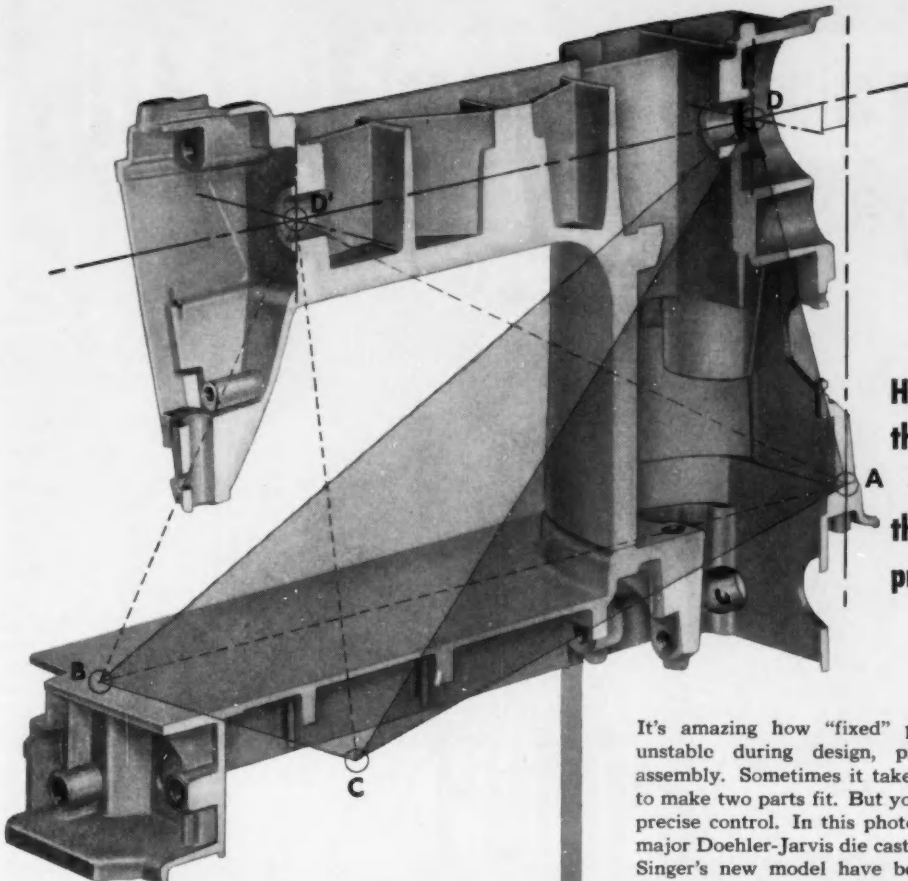
Makers of the Finest in Steering
Gemmer Mfg. Co., Detroit 11, Mich.
INTEGRAL AND LINKAGE TYPES



Here are the "tripods" that control precision

It's amazing how "fixed" points become unstable during design, production and assembly. Sometimes it takes manhandling to make two parts fit. But you *can* establish precise control. In this photograph the two major Doehler-Jarvis die castings that frame Singer's new model have been assembled, then sliced down the middle to show the "Tripod-control" method. An imaginary plane of reference, ABC, controls the bed casting dimensions. It passes through point A, a real point of vantage common to both parts. With this plane as a base, imaginary "tripods" are erected to "fix" the plane ADD' and control arm-casting dimensions. The same planes control precision measurements in all following operations.

into parts

finer than ever

for ganged machining . . . used in finishing . . . used in assembly.

By the time the "Slant Needle" model came along, "Tripod-Control Dimensioning" had grown to a full-fledged design and production technique . . . based on die castings . . . used even in the first rough sketches of the new product . . . used in the planning stages . . . used throughout tooling and production.

Today? Well . . . you never saw production flow more smoothly when complex precision parts are made by one company, finished and assembled by another.

In its half century of die casting, Doehler-Jarvis has helped many producers, large and small, find the best way to take full advantage of die casting techniques . . . among them some of the best known makers of automotive, electrical, communication, household, office and other types of equipment.

Doehler-Jarvis Division

of

National Lead Company

General Offices: Toledo 1, Ohio

DOEHLER-JARVIS

*Reg. U.S. Pat. Off.

When they come to Doehler-Jarvis, they know that Doehler-Jarvis can supply both the resources and the resourcefulness they need.

So next time you have a new product on the boards . . . call Doehler-Jarvis in on the design and production engineering. We may be able to give you just the solid kind of help you're looking for.

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LOWEST LIFETIME COST

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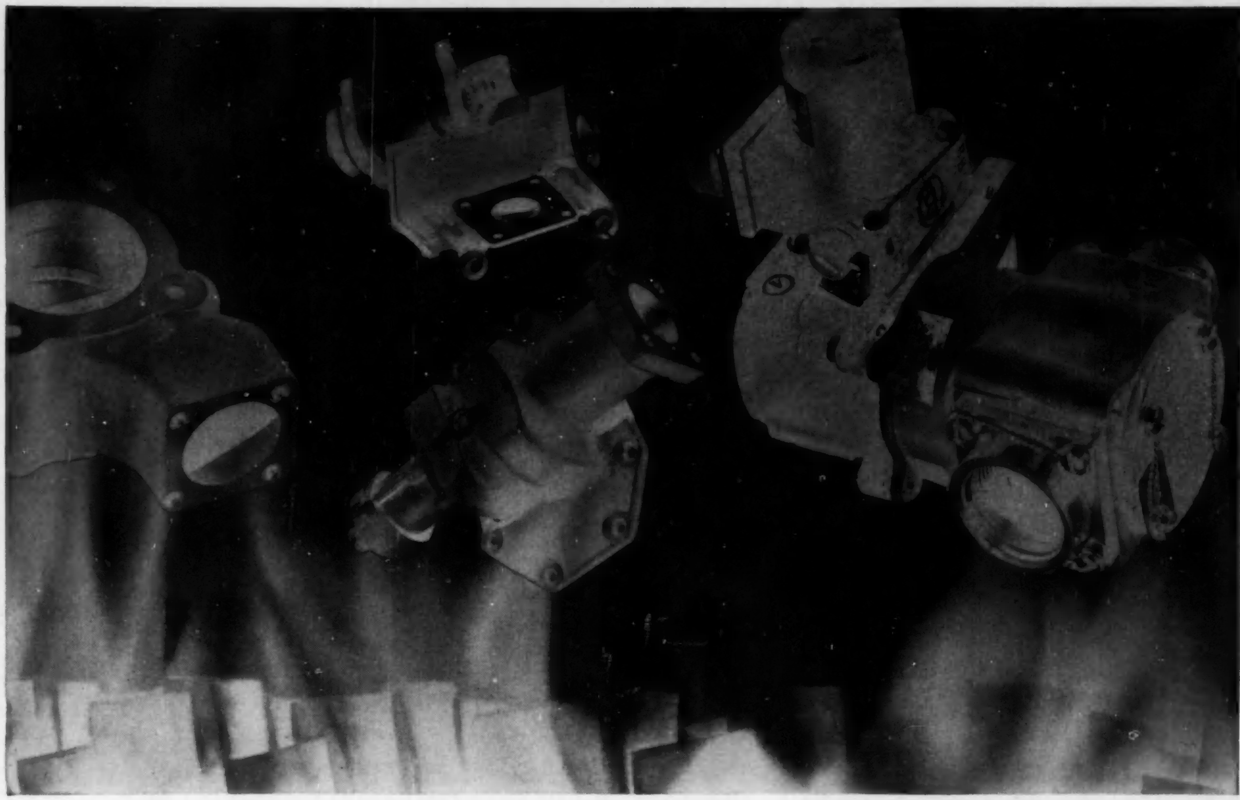
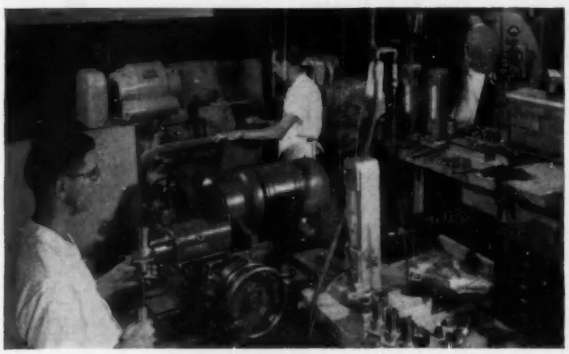
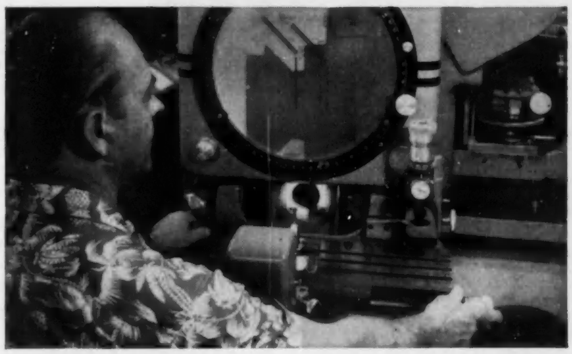
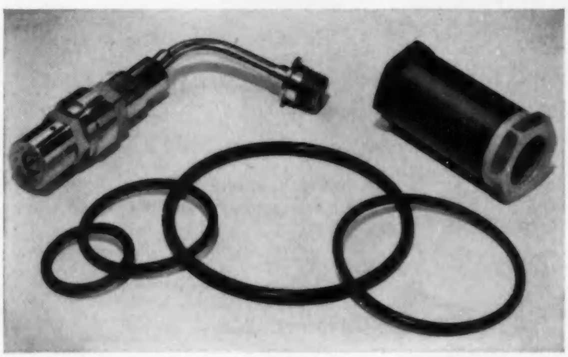




Precision grinding (shown above) on these stainless steel parts is checked to within 0.0001-inch accuracy. Grinders are able to hold 0.0002-inch concentricity between diameters.



Inspections prove quality. Every accessory is 100% tested and inspected. Here's an optical comparator in use. We maintain close customer liaison to correlate test methods and results.



Look at these other Parker products: nozzle and check valve represent accessories for engine *fuel* and *hydraulic* systems. Also, Parker O-rings are approved for *all* military applications.

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Let a CWC engineer help make your planning easier . . . explain how CWC castings make your product better. Bear this in mind whenever you're hungry for *facts.*
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+ INDEX TO ADVERTISERS +

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